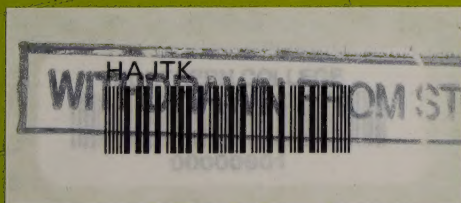
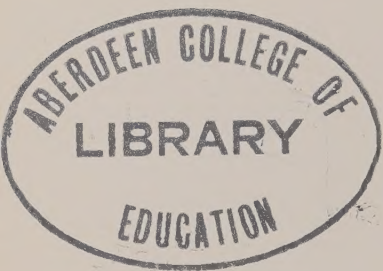




MATCH & MISMATCH

RAISING QUESTIONS: LEADER'S GUIDE





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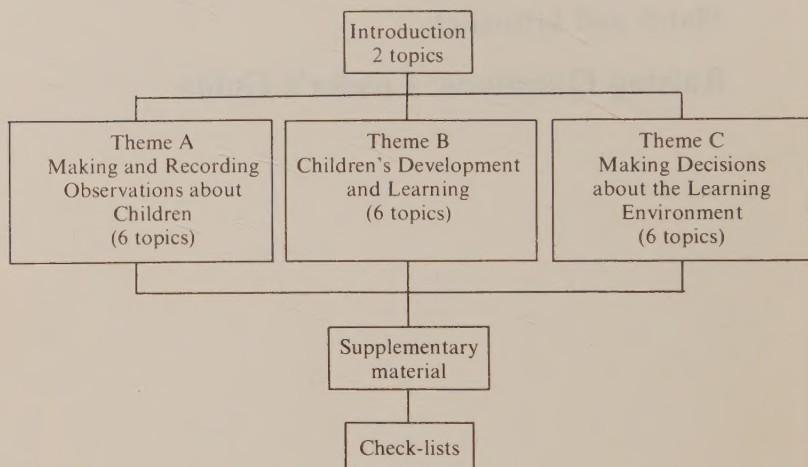
Match and Mismatch

Raising Questions: Leader's Guide

Outline of materials

(a) Books for teachers:

Raising Questions contains 20 topics for study in courses or privately, and two check-lists for assessing attitudes, abilities and concepts relevant to learning science in the 5–13 age range. The material in this book is organized in the following way



After the two introductory topics the three themes can be studied in any order. Topics are not necessarily the same as sessions or meetings. The amount covered in a session will vary with the interest, background and experience of the teachers as well as the length of meetings.

Finding Answers offers suggestions relating to decisions about activities and approaches appropriate at various points in development.

(b) Book for group leaders:

Leader's Guide incorporates *Raising Questions* along with notes about materials needed and suggested procedure for each topic.

(c) Audio-visual material for use during courses:

2 video cassettes (6 sequences)

Audio-visual Pack containing:

4 filmstrips (6 sequences)

6 tape sequences for use with filmstrips

5 tape sequences, sound only

} on 2 audio
cassettes

Match and Mismatch

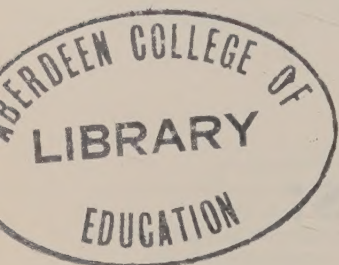
Raising Questions: Leader's Guide

Fitting learning experiences in science to
development for five to thirteen year olds

Wynne Harlen
Sr. Anne Darwin
Monica Murphy

Oliver & Boyd for the Schools Council

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The Schools Council Progress in Learning Science
Project was based at Reading University from 1973-77

<i>Director</i>	Wynne Harlen, B.A., M.A., Ph.D.	
<i>Team Members</i>	Monica Murphy, B.A. Sister Anne Darwin, F.M.A.	1974-75 1974-75
<i>Evaluator</i>	John Elliott, Dip. Phil Ed.	1975-77

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Preface

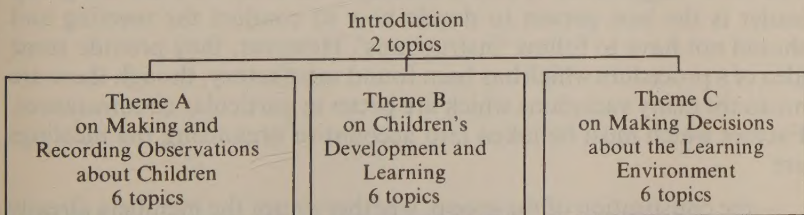
The material for in-service study: some general points for group leaders

The idea for this project arose in response to teachers' requests for help in selecting from the wide range of suggestions for activities now available (see page 231) those which would be most likely to benefit their children, and for ways of finding out whether the children were indeed benefiting. It was soon clear that this kind of help could not be supplied by producing materials alone; materials might be an aid but could not convey the full complexity of issues involved in making decisions about children's experiences, and in recording progress. In-service study gives teachers opportunity to discuss ideas suggested, to generate their own solutions to some of the problems and to have some preparation for using the check-lists and *Finding Answers* in their classrooms.

In building the study material we have tried to provide

- activities* which enable teachers to take part in generating ideas, and so that they have an active not a passive role,
- links* to everyday work in the classroom, so that the practical viability of ideas is immediately explored,
- examples* of what various statements mean in terms of real children in real classrooms, which are given on video-tape, audio-tape or tape-filmstrip sequences.

The ideas suggested for teachers' discussion and activities are presented in the form of *twenty topics*. The topics are grouped into *themes*, which can be studied in any order. Two *introductory topics* give an overview of the project and the kinds of problems which are its concern, followed by whichever theme is felt to be the best starting point for a particular group.



The idea of *matching* activities to development is a key one for this project. We think that in many respects it applies equally to adults as to children. Teachers vary in their ability in and attitude towards

science, in their understanding of children's development, in their powers of observation, in ability to provide for children's active learning; they should not be treated as if these variations do not exist any more than children should be treated as all having the same ability and being at the same stage of development. We have, therefore, tried to produce study material which can be used flexibly so that groups and individuals within groups can spend time on those aspects which are of concern and interest to them.

The features of the material which give this flexibility are:

- (a) The arrangement of topics in themes, any of which can be studied on its own or as part of a course involving other themes.
- (b) When information is presented for discussion there is a choice as to whether it is heard on tape or read in transcript, individually or in groups.
- (c) The time spent on any topic can be decided by each group; some topics will be skipped through rapidly, others may extend over several sessions. One topic is *not* meant to occupy one session.
- (d) In many cases there is provision for a subject to be taken to different degrees of depth. Some more theoretical sections are put in the Supplementary Material so that the more practical treatment is not impeded in the main part of the book.
- (e) Local circumstances will determine the pattern and frequency of meetings. The topics should be regarded as basic raw material which can be divided up and fashioned to fit the most convenient schedule of meetings.

For each topic the *Leader's Guide* gives information about

- a suggested outline of procedure, in the form of a flow diagram,
- the objectives of the topic,
- the materials required,
- more detailed suggestions for each section within the topic.

The word 'suggestions' is used advisedly here, since we think the group leader is the best person to decide how to conduct the meeting and should not have to follow 'instructions'. However, they provide some idea of a procedure which has been found satisfactory, though there are no doubt many variations which are better in particular circumstances. Factors which must be taken into account in organizing the meetings are

- the constitution of the group, whether or not the members already know each other, share interests, have similar responsibilities, etc,
- the length and frequency of meetings,
- the interests of the group and the problems they raise in discussion,

and many more. Variations which a leader may wish to introduce in order to adapt to a particular group are likely to be in respect of

- (a) Small-group discussions. These are suggested at least once in each topic because they often enable teachers to express their own ideas or doubts and problems more easily than in a large group. But if for any reason, such as lack of a successful small-group discussion leader or unwillingness of members to exchange ideas, it is evident that small groups are unproductive, then it would be better not to break up. On the other hand some discussions suggested for the whole group might be better in small groups where these are promoting open exchanges.
- (b) The use of the video-tapes and transcripts. It is generally advised in the notes that video-tapes are viewed and that transcripts are used in discussions following the viewing. In this way one can have a good idea of the situation in mind when reading the transcripts to identify evidence for interpreting the children's behaviours. There is, though, something to be said for reading the transcripts before seeing the tapes; it often reveals how little evidence of any conclusive nature comes from what the children say, and helps in distinguishing between visual and aural evidence. These alternatives should be kept in mind; in practice some variations such as read-watch-read or watch-read-watch may be best, but a leader will have to judge what seems best for the group from their initial reactions. The important thing is for teachers to make sure that there is evidence to support any inferences they make about the attributes of the children they watch, and if one pattern of using the tapes and transcripts does not encourage this, then try another.

Finally another point about the video-tapes. They are not for entertainment or light relief, and if teachers sit back, as they may be used to doing in front of a television screen, they are likely to be bored and to fail to see any significance in the children's actions. The VTRs should be introduced as evidence to be studied, to be seen more than once if necessary, and to be analysed with the help of the transcripts.

Acknowledgements

It is only possible to mention here some of the many people who have shared their expertise with the project team and helped us in a variety of ways, but to all I would like to express grateful thanks. The check-lists included in this book were developed through the efforts of working groups of teachers in various parts of the country and we placed tremendous value on the products of these meetings and for us, at least, the time spent in discussing and writing down observations about children was extremely worth while.

The material in the topics for in-service work which form the bulk of the book constitutes an extensively rewritten and expanded version of first draft material tried by school-based study groups in South Oxfordshire in Spring 1975. We are grateful to those who took part and provided us with their comments, and particularly to Joan Blyth and John Robards of the Oxfordshire LEA Advisory Team, not only for arranging these trials but also for their supporting interest and valuable comments throughout the whole project.

I wish to thank Tony Lee, director of Wessex ETV and his team for helping us to produce the video-taped material associated with this book. David Wilson, of King Alfred's College, also spent many hours with us in planning, organizing and reviewing the video-tapes and I wish to thank him for this and for the help he has given at other times.

It is not out of routine politeness that I offer sincere thanks to the project's Consultative Committee. The members of the committee have done far more than attend meetings and read papers. They have been critical friends who have given their time to consider the project's problems in depth before offering their advice. This has been of particular value to a project with such a small central team as ours. The members of the committee were:

Jim Eggleston, Chairman
Dorothy Alexander
Bernard Beadle
Joan Bliss
Norman Booth
Sister Anne Darwin
John Elliott
Len Ennever
Les Hardy
Loveday Harmer
Nigel Mason

Monica Murphy
Tim Papé
Sheila Parker
Vivienne Refoy
Eryl Rothwell-Hughes
Ken Secret, 1973-75
D. P. Williams, 1975-77
Jack Wrigley
Gwil Williams
Phil Clift 1973-74
Stephen Steadman 1974-76
Jim Harrison 1976-77

} Schools Council

Finally I would like to thank Anne Game, the project secretary, and her predecessor, Gladys Goodwin, for their efficient work and especially for fitting in extra demands at times of pressure.

W.H.
Reading
October 1976

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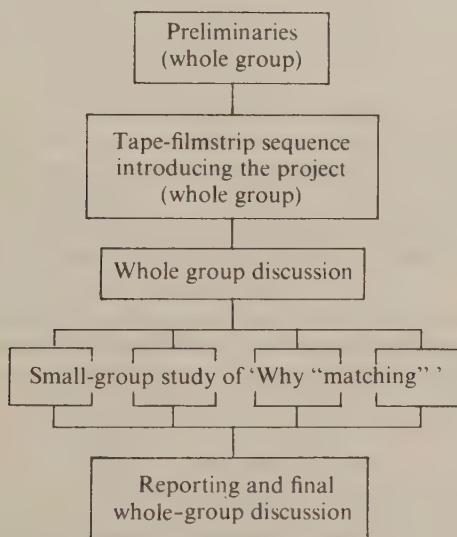
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Match and Mismatch: Raising Questions 1

Introductory Topics

Topic 1: An overview of *Match and Mismatch*

The flow diagram gives a suggested order of events and grouping for discussions. It is offered as a guide-line, not necessarily to be followed hard and fast.



The objectives of this topic are:

- 1 Knowledge of the project's purpose and of the nature of its materials.
- 2 Awareness of arguments in favour of matching children's activities to their development and of the meaning of matching in this context.

Materials required

Raising Questions, pages 1 to 10

Filmstrip projector and screen

Tape-recorder

Filmstrip 1 and cassette 1, side 1, entitled 'An Overview of *Match and Mismatch*'

Tape sequence entitled 'Why matching?'

Suggestions

Preliminaries

If members of the group do not already know each other it will, of course, be necessary to begin this first session with general introductions. Preliminaries about the arrangements for and nature of the meetings will also vary from one group to another depending upon the information already given when the meeting was announced. However the importance of members of the group knowing what is in store for them is underlined, since *if there are wrong expectations of the meetings this may lead to members feeling uncomfortable and unwilling to participate fully*. It is probably worth while, therefore, even at the risk of repetition, to make sure that members are aware that:

- there will be a series of meetings (dates, time and places given if possible),
- the meetings involve critical examination of the ideas proposed and participation in activities which take them further (i.e. the members of the group have an active part to play),
- often there will be some things to do between meetings (and this is important in order to tie the work firmly to classroom events),
- there is flexibility for those involved to choose the areas to be discussed, the time spent on each topic and the depth in which a subject is considered (i.e. teachers can move on from points they feel are not as important for them to spend more time on those which are important),
- the intention is that the meetings should be of immediate and long-term help with daily classroom work (*though the help does not come in the form of suggestions for new activities*, but in proposing ways in which existing resources can be used more effectively).

The first point leads into the subject of what the project is about, and although the tape-filmstrip sequence presents this information a certain amount of introduction may be useful because

- (a) There is often an expectation that courses (and ones associated with Schools Council projects in particular) provide new teaching materials. *Match and Mismatch* does not do this, neither is it suggesting a method of teaching; instead *it is concerned with the development and progress of individual children and the provision of activities which are appropriate to their development and will foster their progress*. It involves the evaluation by teachers of children's learning and of their own work in promoting this.
- (b) The word 'science' may, perhaps, worry teachers who do not feel themselves to be competent in this subject. It may be as well to point out at this stage, and to repeat quite often subsequently,

that science in the primary and middle years implies a way of working, not a body of knowledge. *Many teachers will already be including in children's work the kinds of experience which help children to learn science, even though they may not think of themselves as 'teaching science'.* Science as we interpret it here is an integral and important part of children's learning, not a collection of activities which can either be included or not included without making much difference.

- (c) There is little completely 'new' in what the publications offer. For many teachers these will raise to a level of conscious thought and suggest a systematic approach to what they already do more or less intuitively. We think that the discussions which identify implicit goals and provoke analysis of teaching strategy are as important as any products which emerge; therefore the *course is not just a preparation for using new ideas or materials but is in itself an aid to more effective teaching.*

Tape-filmstrip sequence: An Overview of Match and Mismatch

The transcript of the tape is given on pages 1 to 7.* It is provided for reference afterwards; it will not be helpful for teachers to try to follow it whilst the sequence is being shown.

Before beginning, mention the convention used throughout the book of referring to the teacher as 'she' and the pupil as 'he'. Not a symptom of female chauvinism, but simply a convenience !

Discussion

It is not uncommon to find that a group, though very forthcoming in later sessions, has little to say at this point. There is a great deal to absorb in the 'Overview' sequence and many do not wish to discuss until they have begun to study the material further. It is best not to linger then, if few points are raised, but simply to make sure that teachers have general ideas about the following:

- (a) What the material is, and what it is not, about. Emphasize the aim as helping teachers to make decisions based on relevant knowledge about the children; gathering information and using it is of first importance, and making a record has additional values but is not the prime purpose of the check-lists.
- (b) The meaning of 'science' in this context. Is there agreement with the words which are italicized on page 1? It is very important

* Page references, unless otherwise stated, refer to the teachers' book, *Raising Questions*, which is included in this book following the notes for leaders. Page numbers in this section have been set in brackets to avoid confusion.

that science is understood as a 'way of learning', a basic element in children's early education. (It may be necessary to return to this point several times if there is a tendency to narrow down the interpretation of 'science activities' to situations in which children find out answers to practical problems.)

- (c) The nature of the project's materials and the relation to its aims, as summarized in the diagram on page 5.
- (d) The centrality of the notion of 'matching', which will be a recurring theme through the course. If there are questions about the diagram on page 6, it will be best to delay discussion of them until the section 'Why matching?' has been studied.

Small-group study of 'Why matching?'

Teachers can listen to this on the tape or read it without the tape. Preferences for listening or reading, or both, vary considerably and the early trials showed that it is best to offer a choice. Those who wish to listen, do so; others might be grouped in threes or fours to read and perhaps to discuss as they go along.

Following the study of the tape or transcript discussion within the small groups, discussion can be focused on the questions:

- are the arguments in favour of matching found convincing?
- are there any arguments against matching which should have been given?
- is matching, as interpreted here, enough to promote learning?
- is matching a practical possibility in a group situation?
- does it sound too 'structured', as if forcing a child to 'progress' at all costs?
- is it consistent with giving children freedom to choose their activities?

Whole-group discussion

The whole group discussion can be started by asking each group to respond to one of the leading questions suggested above. It may be helpful to refer to the diagram on page 6 if there is confusion about what 'matching' means; the diagram suggests that it means

- knowing where the children are,
- and then—setting realistic goals,
- and—providing activities and approaches which are appropriate to their development.

The fact that we can never know exactly what goals and experiences are appropriate means that each decision is a 'best approximation'

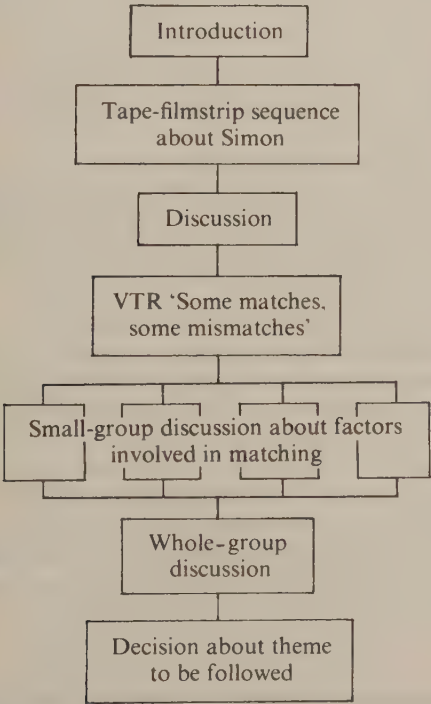
and should be followed up by gathering more information to feed back the effect of one decision to help in making the next.

The section ‘catering for individuals within a group learning situation’ (page 9) provides an example which may be useful in explaining what is meant by matching to variations between individuals without involving isolated learning.

Discussion of what matching means in practice is continued in the next topic, where further examples are provided in the form of a tape-filmstrip sequence showing how decisions about a particular child were based on knowledge of his development.

Topic 2: Helping children learn by learning about children

Flow diagram of suggested order of events and grouping for discussions.



The objectives of this topic are:

- 1 *Appreciation that knowledge of children's characteristics suggests how to help them.*

2 Identification of the variety of factors which influence matching in practice.

Materials required

Raising Questions, pages 10 to 26

Filmstrip projector and screen

Cassette-recorder

Filmstrip 2 and cassette 1 side 1, entitled 'Matching activities to Simon's development'

Video-cassette player and TV monitor

VCR 1, sequence entitled 'Some matches, some Mismatches'.

Suggestions

Introduction

A brief recap of some points from the first topic which lead into the present subject:

- various reasons were given for considering that children learn most effectively through experiences which match their development in the ideas involved,
- this means that decisions about children's activities and approaches must be based on information about their development,
- taking children's individual development into account means that each may have different experiences, but it does not mean that they work independently or on their own.

In this topic we go further into the meaning of matching and some of the factors which have an influence in determining whether there is matching or mismatching in a particular case.

The tape-filmstrip sequence about 'Matching activities to Simon's development' picks out for discussion just some decisions the teacher made about Simon's activities. It is not possible to give a complete account, of course, so the events described should be regarded as examples of ways in which the teacher makes use of her observation of Simon in providing experiences for him. These events took place within the context of everyday working and similar thought was given in the case of the other children in this infants' class.

Tape-filmstrip sequence: 'Matching activities to Simon's development'

The transcript is given on pages 10 to 13. This should be used for reference during the discussion afterwards, not whilst the sequence is being shown.

Discussion

Some questions are suggested on page 13 as a basis for discussion but teachers should not feel confined to these. In the first instance, however, it may be helpful to ask teachers to respond to these questions and then to pursue other points as they emerge.

The leading questions suggested for discussion attempt to raise the issues:

- was Simon's teacher following a ready-made plan of activities for him or deciding what to do in response to his reactions?
- was her method in Simon's best interests?
- if he worked at a different level from his friends on the same activity was he likely to feel inferior?
- what are the advantages and disadvantages of a teacher making decisions apparently 'on the spot' as in this case?

During the discussions teachers should be encouraged to be critically *constructive* rather than critically *destructive*. That is, if they disagree that Simon's teacher's methods were in his best interests they should be asked to *propose methods which are preferred*.

Video-cassette recording: 'Some Matches, some Mismatches'

The introduction on page 13 states the purpose of this video-tape. As noted there, teachers can find information about how the recordings were made in the Supplementary Material.

The transcript of the tape is provided on pages 14 to 24 for reference after the sequence has been seen. During the playing teachers might like to jot down a few comments on a table as suggested on page 24. Alternatively this can be done before and during the discussion which follows the viewing, with the help of the transcript. [But see page (vii) on the use of VCR and transcripts.]

Small-group discussion

After the tape you might ask teachers to divide into small groups to discuss and put down their ideas.

- What aspects of the children's actions and responses indicated a 'match' or a 'mismatch'?
- What factors might have been responsible?

It is not expected that there should be a consensus within each group, but differences which emerge should be brought out and discussed. One person in each small group should be prepared to report briefly the statements recorded by the group. It is often helpful to review sections of the tape during this discussion, as differences in interpretation arise.

Whole-group discussion

Ask one group to report on 'Colin and Stephen', members of other groups contributing comments. After discussion of items under both headings for Colin and Stephen go on to Duncan and Michelle, etc. in the same way.

Some of the points which teachers have suggested are given in the table below. Others could well be added:

<i>Sequence</i>	<i>Indications of match or mismatch</i>	<i>Possible influential factors</i>
Colin and Stephen sorting	Lack of interest, easily distracted by extraneous factors, bored with the material, not involved . . .	Activity may have been too simple, or too difficult (unable to tell which because they were so disinterested), material not stimulating, not chosen by them, too little guidance given . . .
Duncan and Michelle building bridge with paper.	Soon forgot the problem in hand, tackled it without any discussion or forethought about what was required, turned to rather aimless activity . . .	Duncan and Michele mismatched as a pair, probably Michelle capable of tackling problem if Duncan not there, both unable to analyse problem and consider possible solutions, only ready for play with this material, not for solving an imposed problem. Lacked previous experience of this kind of problem . . .
Yolanda and Malbinder building bridge with paper.	See problem as one they can tackle, immediately think of relevant knowledge to apply, work together and take ideas and suggestions from each other, discuss problem and think ahead to consider the weight the bridge has to hold . . .	Good co-operation between them, grasped the problem and could see how to use the materials given, could think out steps needed and weigh alternatives before deciding what to do, had necessary previous experience of structure affecting strength of materials . . .

<i>Sequence</i>	<i>Indications of match or mismatch</i>	<i>Possible influential factors</i>
David and June investigating eggs.	Don't relate their findings to the problems by rational argument, jump to conclusions without any evidence, fail to relate the observed behaviour of the eggs to the properties of their contents . . .	Children not able to consider possible effects of what they cannot see (inside the eggs), limited in ability to link cause and effect, cannot hold various alternatives in mind at one time, competitive spirit between them causes June to be claiming that she is 'right' . . .
Deidre and Allyson investigating eggs.	Consider the alternative interpretations of each finding, each prepared to tolerate and discuss different ideas the other holds, seem completely involved and determined to reach a solution, support their conclusions with evidence . . .	Able to envisage the external effects of different internal conditions of the eggs, can form hypotheses and test them, are able to carry out the mental arguments required by the problem, their discussion helps them to substantiate their conclusions . . .

Decision about theme to be followed

The discussion about factors influencing matching will probably have revealed that it is not a simple matter. It depends not only on the intellectual development of the children compared with the demands of the activity but also on factors such as

- social interaction, between children,
- level of maturity reached in certain attitudes,
- interest in the activity and material involved,
- who selected or proposed the activity,
- the type and amount of guidance given,
- the distractions in the classroom,
- the children's previous experience of problems of a particular kind . . .

There are a great many topics to consider and *Raising Questions* covers several of them grouped in three main themes which focus on different aspects of the process of matching. The rationale for the three themes is that matching involves

- gathering information about children,
- interpreting the information in terms of development,
- using the information to make decisions about experiences.

The summaries of the topics included in each theme (page 25) give some idea of their content. There is no fixed order in which the themes should be studied but the topics within a theme are arranged in a sequential order which it is best to follow.

Theme A on 'Making and Recording Observations about Children' is concerned with *what information* to gather, *how* to gather it and *how* to interpret it.

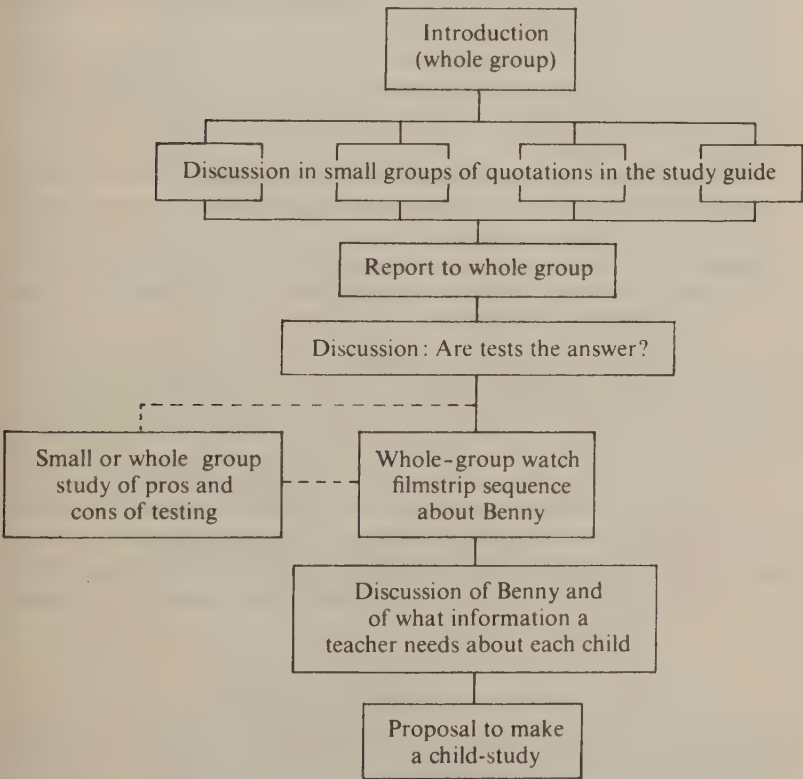
Theme B on 'Children's Development and Learning' is intended to promote discussion about *factors within the child* which affect learning.

Theme C on 'Making Decisions about the Learning Environment' deals with *factors external to the child* which influence learning.

Theme A: Making and Recording Observations about Children

Topic 1: Finding out about children

An outline of group activities and of a suggested procedure is given in the flow diagram below. Dotted lines indicate a branch which involves studying one of the subjects in more depth.



The objective of this topic is:

Appreciation that observation is a feasible and appropriate method for gathering the information about individual children which is required for making everyday decisions about their learning experiences.

Materials required

Raising Questions, pages 27 to 32

Filmstrip projector and screen

Tape-recorder

Filmstrip 3 and cassette 1, side 2, sequence entitled 'Benny'

Suggestions

Introduction

The group could be reminded of the case which has been made, in the Introductory Topics, for finding out about children:

- if we wish to build upon their existing ideas we have to know what these are,
- if we want to make provision for activities which engage their interest and enable them to become involved in their learning it is necessary to find out what kind of things interest them and how to stimulate interest,
- children have their own ways of looking at things; we must know what these are in order to know what sense they are making of their experiences,
- 'matching' can never be exact, but gross mismatching will be avoided if they can choose from a range of activities which suit their ideas and capabilities.

The case for having information about the child may be accepted in theory, but the feasibility of gathering it in practice questioned. The purpose of this Theme is to work towards a practical way of finding and using information about children's development.

The starting point is discussion of methods teachers employ when they want to know about children's abilities; this occurs most obviously when new children enter their class at the beginning of the school year. If there is a large group you may wish to divide into smaller groups of three or four to read and discuss the quotations on pages 27 and 28.

Small-group discussions

Teachers read through quotations and use the leading questions suggested to focus their discussion, i.e.

- Which of the methods in the quotations are felt to be inadequate and for what reasons?
- Which is nearest to the method used by each teacher?
- Which does the group feel is the best approach, even if it is not the one used, and why?

Reporting to whole group

One group may be asked to report their discussion to the others, who give their own views in reply. The above three questions can be used to guide the discussion and others added which emerge from small-group discussion. For example:

- Are different methods best for children of different age groups?
- Does it depend on which abilities and characteristics a teacher wants to learn about?
- To what extent do teachers feel able to make use of records passed on by other teachers?

This last question is an important one for this theme. There is little point in teachers making records unless they are used, but on the other hand they must be more than records of personal impressions.

Are tests the answer?

The limitations of tests which are pointed out (page 28) relate to their use in the context of gathering information for day-to-day classroom decisions. The argument is not against using tests at all, but against using them in this context. Nevertheless even with this restriction in mind some teachers may wish to defend the value of tests and to take the discussion further. In this case it may be profitable to break into small groups to study the paper on '*Pros and cons to testing*' in the Supplementary Material (pages 188–190).

On the other hand if there is general agreement that 'tests are not the answer', the discussion can pass on immediately to the proposition that observation is a method more suited to the purpose we are considering.

After looking at the section '*What can we do instead of testing?*' it may be necessary to stress that:

- what is suggested is not new, but rather an extension and a structuring of a method teachers already use for gathering a great deal of knowledge of children,
- a broad interpretation of 'observation' is assumed, i.e. to include listening and discussing as well as looking at the processes and products of children's learning,
- the validity of the sentence italicized on page 28 is assumed.

The list of advantages of using observation shows that it has many more features which make it ideal for the present purpose than other possible methods of gathering information. It has disadvantages also, of course, which are not mentioned. Teachers may like to note what they feel the disadvantages to be. At the end of the Theme they may look back to see if they would change their minds about any of the disadvantages.

Tape-filmstrip sequence about Benny

The sequence can be introduced by saying that Benny was 10 when this study was made by a teacher who had known him, but not taught him all the time, since he came to the school at the age of 8. The study has necessarily to be selective; what it describes may seem to be isolated instances of behaviour but were in fact representative of many similar actions and responses by Benny which had been observed.

Discussion of Benny

In the discussion after the sequence teachers often ask about Benny's home background. His home life is stable and supportive. His mother is a teacher. There are plenty of books in the home. Benny develops many of his interests at home—his bedroom is crowded with old television sets, gramophones and radios which he enjoys taking to pieces and building up again.

Some leading questions for discussion are:

- how would Benny fare in conventional tests?
- would his written work give a fair indication of his general ability?
- by what methods did the teacher obtain the information she conveys about Benny in the study?
- what kinds of information are included, what range of attributes of the child are covered?

This last question leads to the subject of what information is required about a child—the subject of the next topic. For the moment it is best to keep the discussion to what was mentioned about Benny, not what might or should have been included.

Proposal to make a child-study

Ask each teacher to prepare for the next session a written study of a child who is well known to her. Teachers may be reluctant to undertake this work but they should be encouraged to do so since the purpose is to give a basis for pinning down all that is suggested to the 'real thing'. Experience of trial work showed that teachers who did this felt it was well worth the time spent, those who didn't regretted not doing so. They thought later that it would have helped them understand what was being suggested more easily.

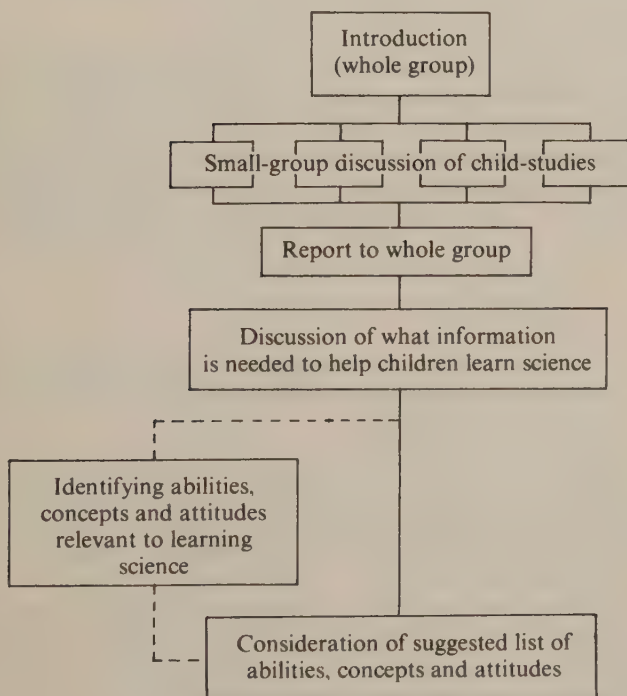
At this point *do not* give any list of the kind of information to include or of the way to express it. Just ask for an account of what the teacher knows about the child which is considered relevant to anyone trying to help the child learn. The length and form of the study can be left

for the individual to decide, but a limit of 500 words might be set if the group members agree.

Ask for the child-studies to be brought to the next meeting.

Topic 2: What information is of most use?

A summary of activities and suggested procedures is given in the flow diagram. Dotted lines show an alternative route which involves studying one of the subjects in more depth.



The objectives of this topic are:

- 1 *Recognition of the range and variety of information needed to help children learn.*
- 2 *Appreciation of the main goals of children's learning in science.*

Materials required

Child-studies prepared by participants

Raising Questions, pages 32 to 34

Suggestions

Introduction

Divide the group into smaller groups of 3 or 4. Ask them to read out their studies in turn to the others, keeping questioning and comment until all contributions have been heard. Whilst listening to others' child-studies, teachers make notes as suggested on page 32.

Small-group discussions

After listening to all the child-studies, teachers might identify the kinds of information which are mentioned in all of them and the kinds mentioned in only a few, and question each other about reasons for including some points but leaving out others. Questions to lead this discussion are suggested on page 32. Each small group should collect its own answers to these questions in preparation for reporting to the whole group.

Reporting to whole group

A suggested framework for this discussion is for one group to provide its answers to the leading questions and for other groups to contribute their ideas in terms of comments.

The leading questions are:

- Which kinds of information were mentioned in almost all studies?
- Which kinds were mentioned in only a few?
- Did some studies omit information which is considered by the group to be important?
- Did some include information which is considered to be irrelevant?
- Is it worth while including factors which are beyond the influence of teacher and school?
- What reasons were given for including or not including particular kinds of information?

What information is needed to help children learn science

Teachers read the project's interpretation of science given on page 33. Discussion of this can be introduced by asking:

If you walked into a classroom how would you recognize that the class or

a group were engaged on a science activity as opposed to another kind of activity?

After the teachers have discussed their own ideas about an answer to this question they may like to consider the project's suggestion under the title 'Is Science being learned here?' (Supplementary Material, page 197.)

Questions which will lead in to the next subject, of what kinds of information about a child are needed for a teacher to help him learn science, are:

- what kind of characteristics and aspects of development affect a child's ability to learn from a particular science activity?
- what characteristics and aspects of development should be fostered by science activities?

Ask teachers to write their own ideas, briefly, as suggested on page 33. At this point we want to consider general kinds of characteristics, not a detailed list.

Examples of responses which teachers have given:

Intellectual level, personality, attitudes, maturity, self confidence, interests.

Personality—introspective or extrovert, level of development reached, previous experience, special interests, speed of learning, attitude, motor development.

When teachers exchange their responses the questions which will immediately arise are:

- What do you mean by 'attitude'?
- Level of development in what respects?
- What is 'intellectual level'?

The point of the exercise is to bring out that a *wide range of information is required* which includes attitudes and personal characteristics as well as intellectual abilities. The evident need to be more specific about what is meant by these terms leads into the next subject.

Going into more detail

Two courses of action are suggested at this point. If a group favours working out its own list of more detailed characteristics before looking at the one suggested by the project, they take the option A. On the other hand if it seems preferable to turn directly to the project's list the path to take is B.

A. In whole-group discussion try to arrive at 3 or 4 broad categories which cover the range of information which was suggested in discussion, e.g. abilities, concepts, attitudes, personality factors. (Do not force these titles but accept what the group suggests.)

Then break into small groups, each group considering one of the categories which have been agreed.

Questions which each group should be addressing are of the following kind:

What (concepts, attitudes, abilities, etc.) are relevant to children's learning, both as prerequisites and as aims of science activities?

Similar questions are suggested on page 34. If it is considered that the choice of items depends on the development of the children, the group should decide whether they are considering the 'earlier' or 'later' period of development in the 5 to 13 age range (or both).

The number of items which each group should be trying to identify is around 8. There is nothing magic in this figure, but it just indicates the order of generality to aim for in the items proposed. Overlap and ambiguity should of course be avoided as far as possible and this is helped by writing a one or two sentence description of the meaning of each item as understood by the group. The discussions may take anything between 30 minutes and an hour.

If the work is completed at the end of a session it is an advantage if each group's list can be photocopied or duplicated so that everyone can have copies of all the lists for the next session.

After reading the lists from all the small groups it will be possible for participants to consider whether the more detailed items really cover the characteristics and abilities which are 'relevant to learning science'. If not, missing items can be added. Duplicated items, or ones which overlap considerably should be thinned out.

Discussion as to which category a particular item falls under (e.g. is curiosity an attitude or a personal characteristic?) is not very fruitful. It is more important to make sure that the list reflects the full range of relevant items than to categorize them.

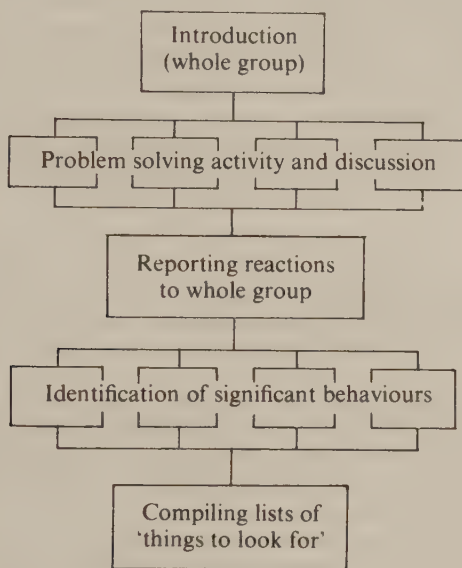
When there is an acceptable agreement about the list it can be compared with the one which other teachers helped to devise for the project (pages 181 to 186). Note that there are two lists, one for 'earlier' and one for 'later' development in the five to thirteen age range. Comparison and combination of the project and group lists is continued in the next topic.

B. Ask teachers to look rapidly over the lists provided on pages 181 to 186 and to decide whether to take the 'earlier' or 'later' development list for more thorough study.

The group can then be broken into smaller groups to read, discuss and write comments about the meaning and importance of each item as relevant to learning science. As suggested under A, 'relevance' here means that the item may be thought of as a prerequisite for learning or an aim of learning. Alternatively this activity can be undertaken by individuals between sessions as a preparation for the next topic.

Topic 3: Recognizing the presence of various characteristics

Flow diagram of suggested procedure:



The objective of this topic is:

Ability to define ways in which characteristics are evident in children's behaviour.

Materials required

Child-studies prepared by teachers.

Raising Questions, pages 34 to 36, and 181 to 186.

4 egg cups, paste-jars, cups, or similar objects } one set per 3 teachers.

Bundle of about 20 wooden spills

Any object which has not been in the room before and which is likely to be unfamiliar in this context, e.g. a large 3-dimensional interlocking puzzle, 'mobile' ornament, costume doll.

Suggestions

N.B. Place the 'new' object on a table where it can be seen by everyone without making any comment or drawing attention to it. If possible do this before the meeting starts.

Introduction

At the end of the last topic the lists of attitudes, abilities and concepts

relevant to learning science suggested on pages 181 to 186 were considered. Teachers will have either compared these with their own lists or made written comments on the items suggested. In either case comments can now be collected together by running through the lists, passing rapidly over items about which there is agreement and pausing to make alterations and additions where considered necessary. Teachers should be encouraged to record comments and changes, as they may wish to refer to them later.

Ask teachers to look through their child-studies again, in particular at the kinds of information which were included about the child, and consider:

- how many of the characteristics on the relevant list just discussed have been mentioned in the study?
- does the list suggest information which should be included in the study?

The question then arises as to how certain information can be obtained about a child. If this information is to be gathered by observing a child's behaviour (actions, talk, and responses of all kinds) we have first to identify the kinds of behaviour from which inferences can be made about various characteristics.

In order to be specific about particular items we have chosen to consider, as examples, the following:

- problem-solving ability,
- curiosity,
- the concept of length,

A problem-solving activity is to be carried out as a means of examining our own behaviour in a situation where problem-solving ability should show.

Please stress that this is an activity introduced here for the purpose of learning to identify behaviours. It is not intended as a diagnostic test of problem solving and it is not suggested that it should become a classroom activity.

Divide into groups of three, each having one set of supports and spills, to carry out the problem-solving activity as indicated on page 35.

Problem-solving activity

Teachers can be asked to note their own and others' reactions which seem to affect their success whilst trying seriously to solve the problem.

The leader should observe the groups and collect instances of behaviour for later discussion. For example the following observations have been made by one leader:

- In one group one person monopolized the material to the obvious frustration of the other two, who soon opted out,
- One group had a discussion before using the apparatus, working out clues to solutions which were suggested by the kind of materials supplied,
- Another group began to try things immediately, working towards a solution by action rather than discussion,
- The groups looked at each others' apparatus (the kinds of supports supplied varied from group to group); one remarked 'but it's easier with your lighter object than ours!'

Reporting for whole group

Ask one group to report on their reaction to the situation. What guided their approach? What gave them clues to a solution or attempted solution? What did they do when one attempt failed? And so on. Invite other groups to comment and add to the list of factors affecting the ability to solve the problem. Keep to reactions felt by the group, not how children might react; the discussion of children's problem-solving behaviours is taken up a little later.

Turn now to *curiosity*. Point out the object which you placed on the table earlier. Ask if anyone felt curious about it? If so how did the curiosity show itself? What does a person do or want to do as a result of curiosity? What kind of questions does he want to ask?

As an introduction to the next small-group activity it may help to recap that the purpose of these group activities has been to focus attention on behaviours which are associated with problem solving and with curiosity. If we are clear about how people act when they are solving problems, or when they are curious, then we can recognize the presence of these characteristics by looking for the associated behaviours. So the next step is to try to identify behaviours which indicate 'problem solving' or 'curiosity' in children.

Identification of significant behaviours

In small groups again, the task is to draw up a list of ten or so statements of what one might look for in *what a child does or says* which give indications of problem-solving ability or curiosity. An example of the form of items suggested is given on page 36. Emphasize that the behaviours must be *observable*, so that an item about what a child 'feels' or 'wants' should be turned into one of how this 'feeling' or 'wanting' shows in what he does or says.

To make sure that both are covered in the time available, suggest that some groups tackle 'problem solving' first and others 'curiosity'

first. If a group completes both before others are finished suggest they draw up a similar list for the *concept of length*.

Compiling lists of 'things to look for'

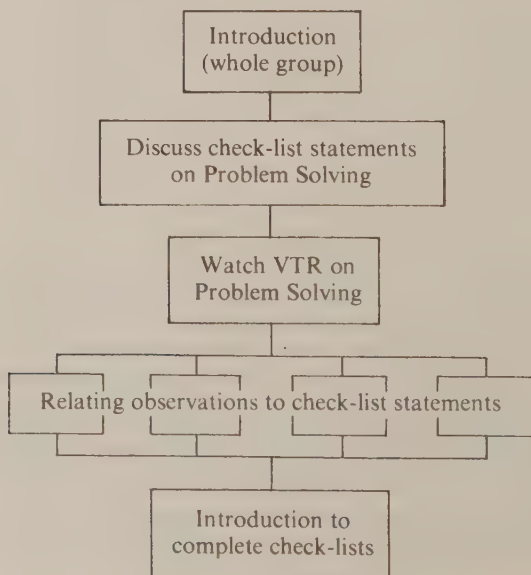
As a whole group collect items relating to 'problem solving'. As one group reads out its list others may find things to add or want to challenge some of those proposed. When all the ideas from the group have been collected and discussed the ones suggested on page 187 can be introduced. A final list can then be prepared by combining ideas from all sources.

In the same way a list for 'curiosity' can be produced, and then for 'length', if it is felt useful to attempt the same kind of discussion on a rather different topic. The discussions could, of course, be pursued for other abilities, attitudes or concepts but the decisions as to whether, or how far, to extend the activity depends on how valuable it seems to be for those involved.

Finally ask teachers to use the lists they have produced in relation to the child they have been studying. They can do this by recording simply which items apply to the child or by devising some way of recording the degree to which each might apply. The results will be needed for the next topic.

Topic 4: Introduction to the check-list statements

Flow diagram of suggested procedure:



The objective of this topic is:

Ability to summarize observations using statements from the check-lists.

Materials required

Raising Questions, pages 36 to 44

Lists of 'things to look for' from previous topic

Video player and TV monitor

VCR 1, sequence entitled 'Problem Solving'

Suggestions*Introduction*

Begin by asking for comments on the attempt to apply the lists of 'things to look for' to the child-study subjects.

If the point is not made by anyone in the group it should be pointed out that the lists may be easy to apply but not so easy to interpret. What do the results mean? It is easier to see this if the statements are arranged in some kind of order. This is done in the check-list statements.

Discussion of check-list statements on problem solving

The three statements about problem solving which appear in the 'Check-list for Earlier Development' are given on page 36. The first statement describes behaviour typical when development of problem-solving ability is in its earliest stages, the second represents some further development and the third the most mature level expected from children for whom the 'earlier' check-list is applicable.

Refer to the list of 'things to look for' which were produced for problem solving:

- try to relate these to the check-list statements,
- make use of this relationship and the observations made on the child being studied in order to apply the check-list statements to the child.

If there are difficulties in relating the 'things to look for' to the check-list items, it may be that the latter should be modified to include a wider range of behaviours. Teachers should be encouraged to propose amendments to the statements to be discussed later and tried out in practice.

Using the statements in relation to the observations made about the child-study subject helps in the understanding of what the statements mean in practical terms. Particular cases can be discussed in the group.

Problem solving (*video-tape recording*)

A transcript of the video-recording is provided on pages 37 to 43, but it is better if teachers use this for reference either before or afterwards rather than whilst the sequence is being shown.

Information about the circumstances in which the video-tapes were made is given in the Supplementary material, pages 198–200. However, it may be necessary to set the scene by stating that the activities had to be 'set up' for the recording, but conditions as near to normal were created within the limits imposed by the presence of lights and cameras. The problem was presented to the children in much the same way as it was presented to the teachers and their activity was recorded for 20 minutes for each pair of children. The sequences extracted were chosen because they show up differences in problem solving ability between the children.

Before beginning, ask teachers to keep in mind the three statements about problem solving and the remarks on page 36.

Small-group discussions

Questions which might be discussed in small groups after watching include:

- Did teachers agree with the description of the various children's problem-solving ability implied in the commentary?
- What were the aspects of Andrew and Mark's approach which indicated further development as compared with Aidan and Jane?
- What factors beside the nature of the problem might have affected their performance?

Whilst discussing the meaning of these statements try to describe the problem solving of Aidan, Jane, Andrew and Mark in the terms of the suggested levels:

- e.g. Aidan — between 1 and 2?
- Jane — between 2 and 3?
- Mark — ?
- Andrew — ?

After 'problem solving' the discussion can proceed on similar lines relating the 'things to look for', 'curiosity' and 'length', to the check-list statements for these items.

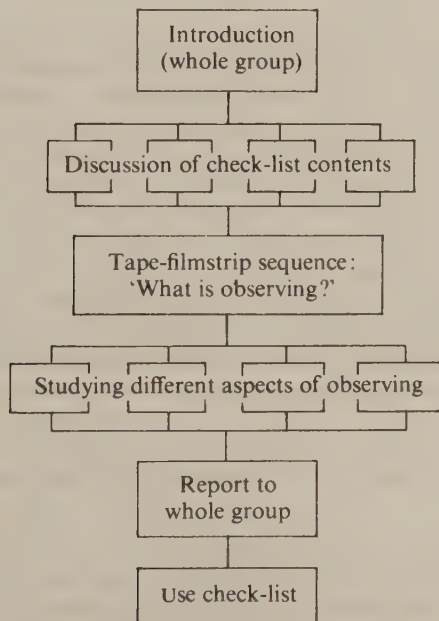
Introduction to the complete check-lists

As a whole group discuss any problems arising during the small-group discussions and exchange suggested amendments to the check-list statements so far studied.

The two check-lists appended at the end of the book are now introduced. They consist of statements, similar in function to those so far studied, for all characteristics suggested as relevant to learning science (topic 2). In preparation for detailed study of these, teachers choose the list which is more appropriate for the children they teach and read through it, noting queries and comments, before the next session.

Topic 5: Familiarization with the check-lists

Flow diagram of suggested procedure:



The objectives of this topic are:

- 1 Knowledge of the contents and intended uses of the check-lists
- 2 Awareness of methods for observing a wide range of children's behaviours.

Materials required

Raising Questions, pages 44 to 51 and Check-lists, pages 249 to 251

Filmstrip projector and screen

Tape recorder

Filmstrip 4 and cassette 1, side 2, sequence entitled 'What is Observing'

Suggestions

Introduction

Teachers will have read the introduction to the check-lists but may still be not quite certain of the intended use and purpose of the check-list. Since it is very important that these things are clear it may be useful to begin by summarizing the introductory notes:

- 1 The purpose is to guide observation of children's behaviour in everyday activities.
- 2 The statements in the list are structured so that observations are interpreted in terms of points in development of various abilities, concepts and attitudes.
- 3 The information about development gathered in this way is for the purpose of helping in matching activities to children's capabilities.
- 4 Inferences about a child's development are not made from any one observation but from clues picked up in a variety of situations.
- 5 The items on the check-list describe behaviours which are quite normal in the course of children's development; a child at level 1 or 2 is not less 'good' than a child at level 3, but is simply at an earlier point in development. It is important to acknowledge this in order to help the child.
- 6 The observations do not have to be recorded in order to be used. A record made occasionally (no more than 2 or 3 times a year) has several values (which will be discussed in more detail in the next topic) but the making of such a record is not the prime purpose of the check-list.
- 7 The check-list might best be regarded as an aid to extending and strengthening a method of getting to know children which teachers already use.

Detailed comments on the content of the check-lists are best considered in the small-group discussions, so deal only with queries of overall purpose and intended use at present. Teachers may query the desirability of 'categorizing' children, or of recording on paper that a child is at an immature stage in 'open-mindedness', for example. Such questions should be discussed fully as they reveal a possible misunderstanding of the use to which the information is to be put. Descriptive information may have been confused with judgment.

Discussion of check-list contents

Divide into small groups of three or four who have chosen to study the same check-list. Leave plenty of time for this, as teachers find the close scrutiny of the statements most useful and it gives opportunity for misconceptions to be cleared up.

Each group works through the items in one list, passing rapidly through statements which present no difficulty but discussing cases where queries arise about the meaning or appropriateness of particular statements. Encourage teachers to use criticisms as a basis for modifying existing statements and for extending the list if it is considered that additional characteristics should be included. i.e. 'I don't think this statement is at all clear' should lead to discussion of what others take its meaning to be, and a rephrasing of the statement to convey the agreed meaning more clearly.

Tape-filmstrip sequence: 'What is Observing?'

Questions may well have arisen, in working through the check-lists, as to how particular kinds of behaviour can be 'observed'. If we take 'observing' to mean 'looking' only, then there do seem to be real problems—especially for items such as 'cause and effect' or 'critical reasoning', etc. The aim of the tape-slide sequence is to extend the meaning of 'observing' beyond 'looking' and to open up discussion of what aspects of observation are most suitable for gathering particular kinds of information.

The transcript of the tape is provided on pages 45 to 49 for reference afterwards. The tape is a long one and could be divided into two parts by pausing at the end of paragraph 3 on page 47 and turning then to the transcribed conversations on pages 192 to 196. The activities suggested as a follow-up to the tape-filmstrip sequence are best carried out in small groups.

Studying different aspects of observing

The activities under 'Observing varying kinds of behaviour' and 'Developing skills in observing' can be undertaken in any order.

When the table is being completed the entries can either take the form of ticks in appropriate spaces (more than one source can be ticked for an item), or a system could be devised for indicating the importance of a particular source. Completing the table helps teachers to recognize how different kinds of information can be gathered and the final table shows the value of the various aspects of observation.

Activities 1, 3 and 4 under 'Developing skill in observing' have greater value carried out in a group than by individuals between meetings but the making and playing of a tape (2) can be suggested as something teachers should do on their own.

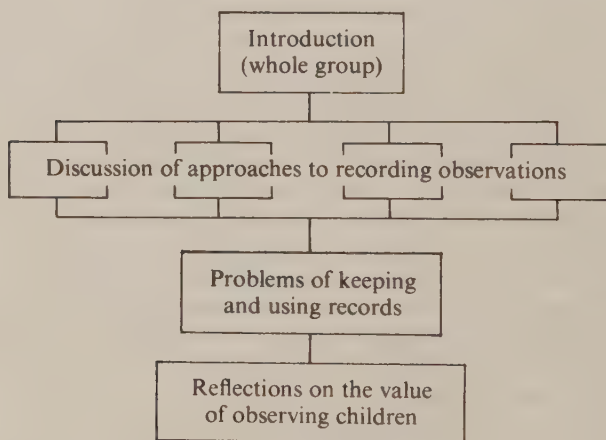
Reporting to the whole group

One group might report to the others on their discussion and conclusions from the activity they have carried out, and other groups

contribute their comments. Different groups might report different activities.

Ask the members of the group to use the whole of the relevant check-list, incorporating any changes they may have made, for the child they have studied and to bring a record of the observations to the next session. At this point *do not* discuss what form the record might take; leave the method of recording for individuals to decide, but ask for the result to be brought to the next session.

Topic 6: The value of making and recording observations



The objectives of this topic are:

- 1 Recognition that structured observation can increase our knowledge of children.
- 2 Appreciation of some ways in which records of observations can be used.

Materials required

Raising Questions, pages 51 to 58.

Record for one child of observations relating to the check-list.

Suggestions

Introduction

Collect first reactions to using the check-list and discuss problems, drawing attention to the comments on page 51. It is important that the

topic of record keeping does not overshadow the purpose of making observations and the value of making immediate use of the information gained. The italicized words on page 52 should be repeated whenever the discussion turns to criticism of records *per se*. It is true to say that for one of its uses, that of providing immediate feedback for making on-the-spot decisions, there is no need to make any record at all of observations suggested by the checklist. However the making of records—infrequently but systematically—adds to the values of making the observations. It is these additional values which are our concern in the present topic, though these still relate to information for a teacher's own use. One of the additional uses which comes more easily when records are made is provision of information for a teacher to evaluate her own progress in helping her pupils.

The starting points for the discussion about records are those which teachers made after applying the whole check-list to the child under study. After a brief review of the different forms of record used it is best to break into small groups for more detailed study.

Discussion of approaches to recording observations

Beginning with the form of record for an individual child, teachers should read through pages 52 to 54 and discuss the advantages and disadvantages of forms of record used in the examples.

Notes

- (a) The record of Benny is laid out so that each item is considered on its own, and comparison between them is not invited. Such comparison is not, of course, valid since 2 on one item has no quantitative equivalence with 2 on another.
- (b) The block diagram is much neater and provides a more easily grasped profile, but invites quantitative comparison between items. At the top of page 54 the attitudes are recorded by ticks—this provides, more easily than a block diagram, for records at a later stage being at both a lower and a higher level.
- (c) At the bottom of page 54 the five boxes have been used again, but without blocking in all spaces up to the level observed. This reduces the tendency to make quantitative comparisons between items, but at the loss of the visual impression of a profile.
- (d) The cumulative record of Simon shows how progress can be shown up by keeping records. Here the attitudes are recorded without blocking in all boxes to the left, thus enabling regression as well as progress to be recorded. Regression in the case of skills and concepts is thought to be less likely than for attitudes.
- (e) In the whole-class record the teacher sees a reflection of her success in providing opportunities for children to achieve the whole range

of goals. If some columns show many children to be at lower stages of development, a teacher might well look hard at the provision she makes for children to achieve a particular ability, idea or attitude.

- (f) The whole-class cumulative record shows even more clearly whether a teacher's intentions about helping progress in all aspects are translated into learning experiences as seen by the children. It is worth while for groups to spend some time on this record searching for clues to answer the questions posed on page 57.

Problems of keeping and using records

After the small-group discussions it is valuable to report back to the whole group the major issues which have been raised and any conclusions reached as to preference for one or another type of record. Generally the time involved in making records will be raised as a drawback, and it is necessary to emphasize that the recording will only be done infrequently and will not involve a great deal of time *if* observations have been a routine part of everyday work. But a more important argument concerns whether the time which *is* taken up is justified by the benefit the process brings—this applies equally to the time involved in observing as to that used for record keeping.

Reflections on the value of observing children

'Begin by looking at your children for assuredly you do not know them at all'
(Rousseau)

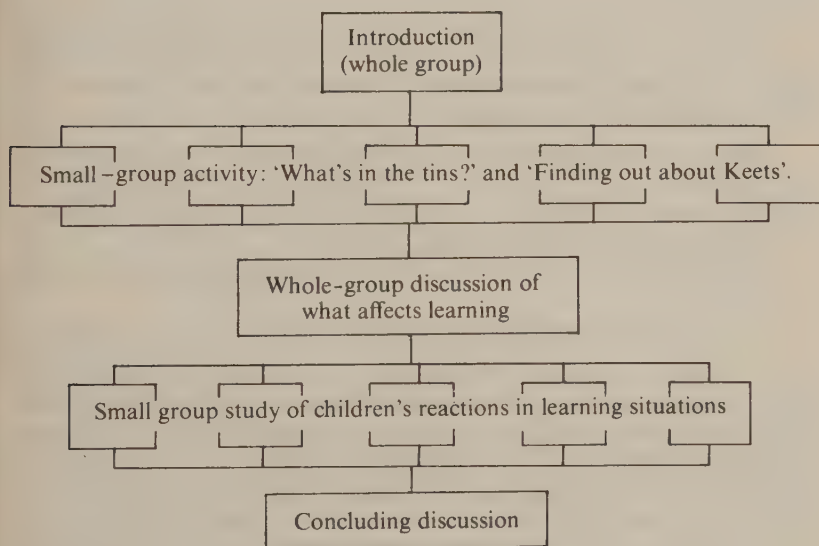
The final discussion might consider the questions:

- Does knowing our children help us to help them?
- Has observing one child resulted in more being known about the child?
- Has the teacher benefited from knowing the child better?
- Has the child benefited from the teacher's greater knowledge?

Theme B: Children's Development and Learning

Topic 1: Exploring children's thinking and feelings

An outline of activities and a suggested procedure is given in the flow diagram. As there are no audio-visual materials used in this topic there can be considerable flexibility in respect of small and whole group discussions. It is necessary to work in small groups for the activity with the tins, but if points made in discussion after this are similar in all small groups it may not be necessary to come together for reporting to the whole group before studying the section on children's reactions.



The objectives of this topic are:

- 1 Awareness of the variation between children in their reaction to the same experiences.
- 2 Appreciation of some of the important factors which affect how children react to, and what they are likely to gain from, an experience.

Materials required

Raising Questions, pages 59 to 66

Tins for the activity on page 60—one set of 3, labelled A, B and C, for each group of 3 teachers. Suitable tins are the ones which contain 35 mm films (obtainable free from local photographic developing firms). Others could be used, but should be cylindrical—so that they can be rolled—and have a well-fitting lid. Objects to put inside:

- a marble
- a piece of metal which will not roll, e.g. cube shaped, or a stout nut and bolt
- a lump of Blu-Tack (or similar), about the size to fill a dessert spoon, stuck firmly to the inside in a lump.

Suggestions

Introduction

It is useful to begin by recapping some of the points made in the Introductory topics about the factors relevant to whether there is a match or mismatch between the activities and the pupils' abilities to learn from them. The ones most significant here are

- the children's ability to carry out the kind of thinking required by the activity,
- their level of maturity in certain attitudes, such as co-operation, perseverance, openmindedness,
- their interest in the activity, whether the problem was felt to be 'theirs',
- their previous experience of similar problems or related activities.

In this theme the factors which the child brings to the learning situation are considered—his attitudes, interests, ways of thinking and his past experience—and we work towards some ideas of how information about these factors can be used to create an environment in which he has most opportunity to learn. This first topic explores in more detail, starting from concrete examples, what are the factors influencing learning and how they differ from one individual to another.

As a start we look at our own reactions in two situations, one of problem solving and one of finding information. Divide the whole group into smaller groups of three. They have a set of three tins in each group and carry out the activity on page 60 under 'What's in the tin?'.

Small-group activity

Notice how the groups vary in their approach.

- Do they discuss one tin at a time, or try one each, or take turns to try all three?
- What different actions are tried—shaking, rolling, tossing?
- Are there signs of one person 'taking over' the activity, whilst another is squeezed out, or opts out?

Make sure that the ideas within a group are *written down*, whether or not agreed upon by all three, before they look inside the tins.

The purpose of the activity with the tins is, of course, to provide a situation in which reactions can be examined. Thus the next step, of writing down personal reactions as suggested on page 60, is important, and teachers should be urged to do this in the way suggested.

When the list of factors proposed by each one has been discussed in the small group, suggest that they turn to 'Finding out about Keets' on page 60.

If this piece of 'information' seems pointless to some it may be worth while to pursue the inconsistency between being able to answer factual questions about keets and understanding what a keet is.

What inhibits the understanding is probably the conflict with existing knowledge. The 'facts' about keets don't fit into an existing pattern of ideas about the possible properties materials can have.

The important point is the role of existing ideas in the understanding of new experiences and information. If we ignore this we may mistake knowing the facts—e.g. ability to answer the questions about keets—for knowing their meaning.

Whole-group discussion

- (a) After discussing keets it may be a good point to exchange ideas within the whole group. As a start ask one group to present the items they have listed about their reactions on page 60. Other groups can then suggest additions or changes, adding anything which arises as a result of the introduction of keets.
- (b) Would this list of factors apply equally in the case of children? What differences might there be for children?
- (c) Introduce the subject of going further into children's reactions. What evidence can be found in the transcribed conversations of children on pages 61 to 63?

To encourage teachers to read these pages, searching for indications of the factors which are operating, it may be a good idea to go through pages 61 to 63 pointing out the kind of comment which could be made on what the children say.

For example:

Lesley:	We're not going to work together are we? Oh—that doesn't give me a chance.	<i>She approaches the situation in a competitive spirit—possibly indicates her unwillingness to co-operate?</i>
Lesley:	Can we write down the facts?	<i>Perhaps used to being told what to do?</i>
Lesley:	Can I keep it secret from the others?	<i>More evidence of competitive rather than co-operative approach.</i>
Lesley:	What do you call those things...	<i>Linking to past experiences.</i>
Dennis:	I think there is definitely... etc.	} <i>Ability to envisage external effect of unseen internal conditions.</i>
Dennis:	It's not going to make any effect unless it's... etc.	
Lesley:	Oh, gosh... do we have to...	<i>Feeling inadequate?</i>

Small-group study of transcripts of children talking

Working in small groups again ask teachers to write comments on the possible significance of the children's words, somewhat as suggested above. Before the work is started, draw attention to the first paragraph after the last conversation on page 66.

When a group has finished studying the transcripts ask them to draw together the kinds of factors which they feel are important influences on children's learning, using evidence from their own experience to add to that from the transcripts.

Concluding discussion

Has the study of the transcripts brought to light more factors which should be considered?

Draw together the whole list of influences. There will no doubt be references to factors outside the child—the teacher's behaviour and that of other children, for example. As previously mentioned, the factors considered in this theme are those relating to the child's development and past experience, but these have to be treated as part of the more complex array of influences.

The next topic takes up the subject of the effect of attitudes on learning, and the way in which attitudes develop. *In preparation* teachers might observe the differences in reactions of children to a particular situation (something like the problem of the tins is suggested), focusing attention on the effect of attitudes and personal characteristics.

Topic 2: Attitudes and how they develop

There is a great deal of material in this topic, which could well occupy several sessions, according to interest. There are many alternatives to the suggested procedures outlined in the flow diagram on p. 35, in addition to the choices which are indicated within it. For example some groups may prefer to hear the audio-tape together rather than read it or listen in small groups. If the tape is heard by the whole group it will be worth while to break into small groups afterwards to discuss 'What attitudes?'.

After the discussion of 'perseverance' there is a choice of small-group study of the sections in *Finding Answers* on 'curiosity', 'co-operation' and 'responsibility', or making only a brief reference to these and suggesting that they are read later.

Similarly the next point could be to develop ideas about one or more of the attitudes 'originality', 'open-mindedness', 'independence', 'self-criticism', working in small groups. Alternatively one or more of these could be considered more briefly by the whole group. The choice will depend upon the interests of the group; the important experience is that of contributing ideas rather than receiving them, but how far this is to be pursued for different attitudes must be judged from the response of those involved.

The objectives of this topic are:

- 1 *Further appreciation of the effect of attitudes upon learning.*
- 2 *Discussion of the possible pattern of development of attitudes.*

Materials required

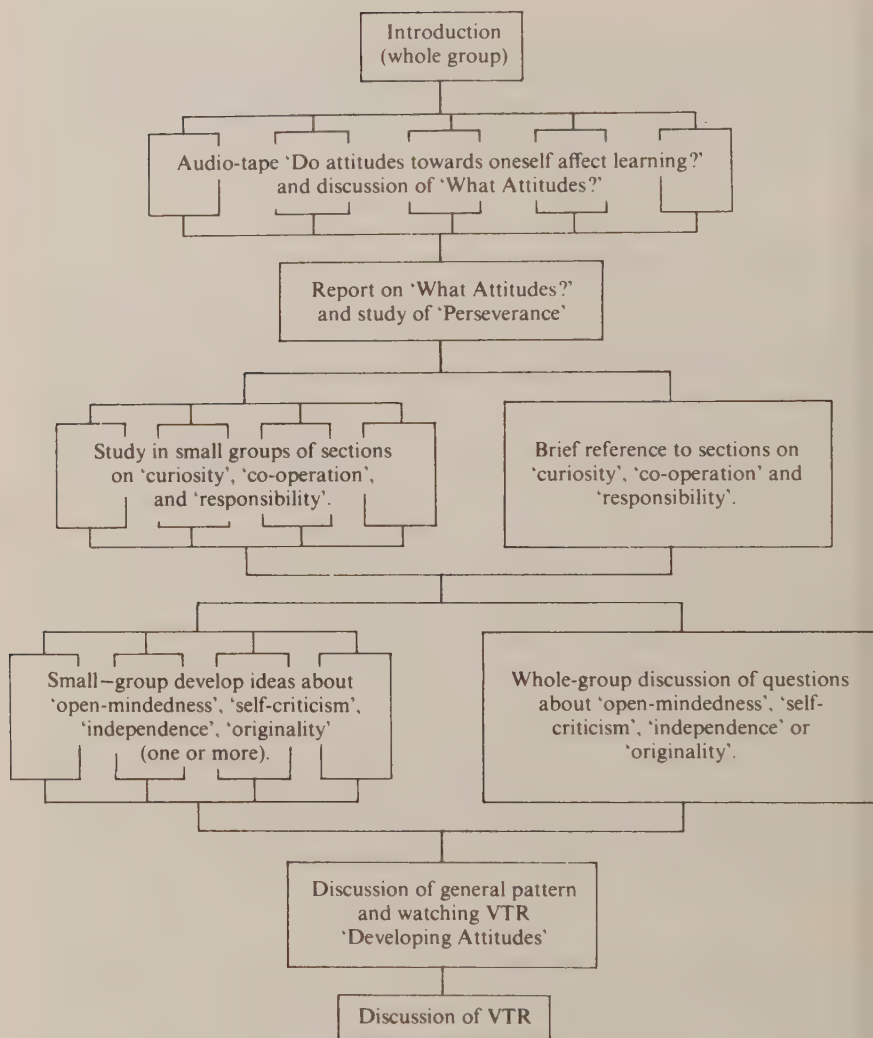
Raising Questions, pages 66 to 81

Tape-recorder

Cassette 2, side 1, sequence entitled 'Do Attitudes towards oneself affect learning?'

Video-cassette player and TV monitor

VCR 2, sequence entitled 'Developing Attitudes'



Suggestions

Introduction

The subject of this topic is introduced in the first section on page 66. The meaning of the word 'attitude' varies considerably from person to person and it is worth spending time on the suggested definition and on the quotation from Evans' book. Sometimes the conception of attitude is restricted to 'liking' or 'disliking' or considering a thing to

be 'good' or 'bad'. The conception must be widened to cover different kinds of responses towards a variety of objects or experiences, especially the three listed on page 67.

'Do Attitudes towards oneself affect learning?' (audio-tape)

Teachers can listen to this on tape or read the transcript privately. If small groups are formed at this point the discussion afterwards can go straight on to the question 'What attitudes?' (page 69). Otherwise form small groups after hearing the tape.

What attitudes?

It might be helpful to recall reactions to the problem of the tins in topic 1 as a basis for identifying some attitudes which affect behaviour. We should have in mind, however, what is relevant to *children's* reactions in these and other situations.

Encourage teachers as much as you can to *write* down their comments. If there is reluctance, try to find out the reason for it. It may be that the understanding of 'attitudes' is not clear and further discussion on more general lines is appropriate. It may be, on the other hand, that certain attitudes of the teachers are inhibiting their participation (self-consciousness, feeling 'no good' at this kind of thing?). The realization may help to overcome the problem.

Whole-group discussion on 'What attitudes?'

Bring together contributions from the small groups. It is generally found that there is a lot of overlap and that different words have been used for essentially the same attitude.

Put beside the group's list the eight attitudes which have emerged from the project's earlier work with teachers:

Curiosity, originality, willingness to co-operate, perseverance, open-mindedness, self-criticism, responsibility, independence in thinking,

and see to what extent these eight cover the ones suggested by the group. If important ones are not covered then these should be added to the list for later discussion.

Perseverance

It is useful to consider various aspects of this attitude in the whole group as a guide to the points which might well be raised later about other attitudes.

The statements on pages 70 and 71 are a précis of the section on perseverance in *Finding Answers* (pages 36 to 43).

For each section, that is:

- What is it?
- Why should we encourage it?
- How does it develop?
- How can it be encouraged?

Read through each section and discuss the questions which follow before going on to the next section. In the discussion ask for examples from the classroom which illustrate the points teachers make.

At the end of this section mention that ideas about perseverance, as resulting from discussion with other teachers, are given on pages 41 to 43. Other parts of *Finding Answers* deal in a similar way with 'Curiosity' 'Co-operation' and 'Responsibility'. A decision has now to be made about whether to study these sections in detail at this point or to suggest that they are read privately later.

Curiosity, co-operation, responsibility

These are to be found on pages 12 to 35 and 44 to 58 of *Finding Answers*. Three possible courses of action are:

- to refer briefly to these pages indicating that they attempt to discuss and illustrate for these three attitudes the four questions that were posed in respect of perseverance,
- or to break into small groups to read one or more of the sections and to discuss the points made,
- or—if this coincides with the end of a session the sections could be read privately between meetings.

Open-mindedness, self-criticism, independence in thinking, originality

For these remaining four attitudes in the list chosen by the project, discussion questions only are given. The discussions here might well be extended to further attitudes which the group felt should have been included (see discussion of 'What attitudes?'). Again there are several ways of using them:

- as a whole group, to take one at a time and to discuss in much the same way as for perseverance. This might be done for one only or for more,
 - or to break into small groups, each choosing one of most interest to the group, or all four, one at a time,
- followed by
- reporting to the whole group.

Discussion of general pattern and watching the VCR 'Developing Attitudes'

There will probably have emerged from the points made about the various attitudes a pattern which seems to apply to many of them.

Read through the characteristics, listed on page 72, of the immature and mature forms of attitudes. How does this agree with the pattern which emerged from the group discussion?

Exact agreement is not important, but the discussion should bring out the points that:

- our expectations of children should take account of their level of maturity in certain attitudes,
- the children should not be 'blamed' for having immature attitudes, but rather this information is important so that we can create the kind of environment which will encourage further development.

(The subject of the teacher's role in encouraging attitudes and interests is taken up in a topic in Theme C 'Making Decisions about the Learning Environment'.)

The transcript of the VCR 'Developing attitudes' is given on pages 73 to 81. The recording gives examples which illustrate various levels of maturity in the attitudes 'willingness to co-operate' and 'open-mindedness'. It is worth repeating the point made in the commentary that the particular examples would not be used on their own to draw inferences about the children's attitudes, but they illustrate the kind of evidence on which such inferences might be based.

It is likely that you may wish to stop after the sequences on 'co-operation' to discuss these before going on to 'open-mindedness'.

Points for discussion

Five suggested discussion points are given on page 81.

For 1, 2 and 3 look over the transcripts relating to the particular children, and encourage teachers to give the evidence for the statements they make about the children. Teachers should feel free to challenge the points made in the commentary about the children but should back their arguments with evidence from the transcripts.

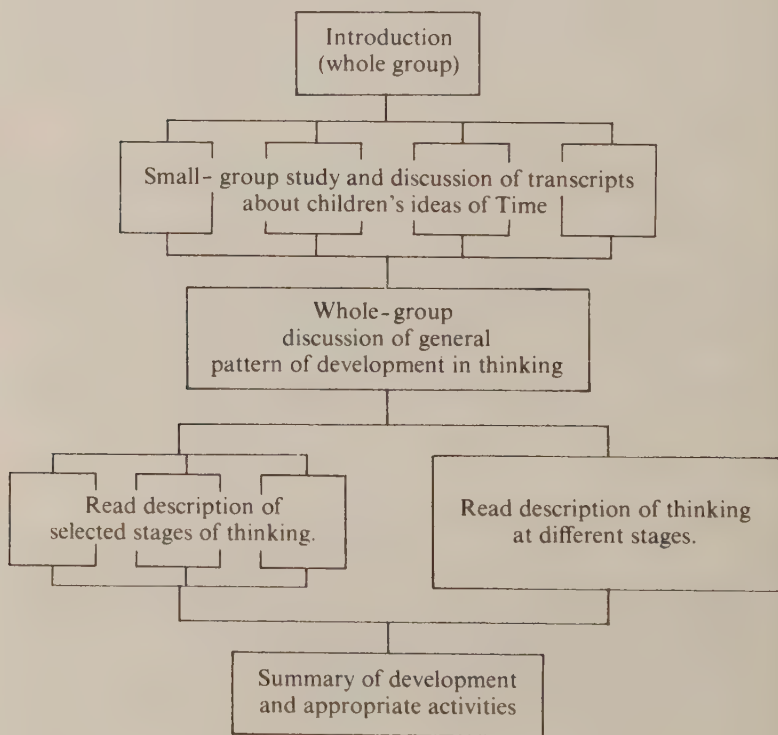
The fifth point is important because it provides opportunity for teachers to relate the discussion of attitudes to their own experience.

Topic 3: Different ways of thinking

This topic begins with some evidence, in the form of transcripts of conversations with children, of development in children's thinking about time. The idea that there is a general pattern in development is then introduced and the work of Piaget is used to fill out the details of

this pattern. Piaget's description is used because the project team has found it accords with experience, but we are not asking teachers to 'swallow' Piaget's ideas if they find their experience is in contradiction. The important thing is to study the evidence for ways in which various ideas develop rather than to argue about the rights or wrongs of Piaget.

There will be variations to the suggested procedure outlined below according to the concerns of members in the group. In some cases it may be appropriate for teachers to read the text on all three stages (Supplementary Material pages 213 to 220), but in other cases only the two most relevant may be considered.



The objectives of this topic are

- 1 *Appreciation of the patterns in children's intellectual development.*
- 2 *Discussion of the application of Piaget's ideas to recognizing stages in intellectual development.*

Materials required

Raising Questions, pages 81 to 92 and 213 to 220.

Suggestions

Introduction

From the study in the last topic of attitudes we turn now to another of the major factors identified earlier as affecting learning, the children's development in ways of thinking. We plan to work from the study of change in particular ideas towards a description of the general pattern. The concept of time is the starting point, chosen because it is an important goal of education whether or not science is included as such in the curriculum, and its development extends right across the age range we are considering.

Some evidence of development of ideas about time emerges from the transcripts given on pages 82 to 88. (The conversations were recorded as they occurred, in normal classroom activities, where the background noise was too much for prolonged listening.) Ask teachers to break into small groups of three or four to study these in the manner suggested below.

Small-group study and discussion of transcripts

- (a) Suggest that the groups read the three conversations about *birthdays*, then discuss what can be gathered about the meaning of birthdays for Jack, Julian and Angela. Statements should be substantiated with evidence from the children's words.
- (b) Go on to the conversations about *time, speed and distance*. Again look for evidence from which inferences can be made about the ideas of Angela and Pauline.
- (c) Read the excerpts from the discussion of *heart beats* and compare the responses relating to time of the older girl Sarah with the younger Julia.
- (d) Finally the conversation between Mark and his teacher about *speed and acceleration*. What were the advances in Mark's ideas involving time compared with the other children? In what ways were his ideas still limited?

Ask the group to continue on to page 88 and compare their statements about the children's ideas with the ones which are given. Knowledge about the children not given in the transcripts has been used to fill out the picture of their concepts of time, but these should nonetheless be consistent with the evidence which is given. Discuss any disagreement between what the teachers inferred and what is given on page 88.

Whole-group discussion of patterns of development in thinking

As a general summing-up of the study of time look at the 'possible pattern' in development of the concept of time on page 89. Here various aspects of the concept of time are considered separately. Teachers might suggest more aspects which could be included.

The statements on the left-hand side share common features as do those on the right-hand side. These are given under the heading *A general pattern?*

Does this more general pattern fit in with the separate patterns above, and with the ideas of the children as inferred from the transcripts?

The next point is to suggest that this general pattern applies to the development of ideas besides time. It may well have been noticed already that the children's notions of time seemed to reflect certain ways of looking at things round them.

To examine the general pattern further we follow Piaget's description of development. Read through the introductory section in this subject: *the stages in development described by Piaget*. Discuss the three points (a), (b) and (c) carefully for it is important for the teachers to appreciate that Piaget

- does *not* treat development as discontinuous,
- does *not* link stages to ages (the figures given are only the most general indications which do not hold for individuals),
- does *not* consider that growth is the one factor which determines mental development.

These points will become clearer as the study of subsequent sections proceeds and it may be worth while repeating them more than once at later points.

'Descriptions of thinking at different stages'

There are three sections relating to three of Piaget's stages given in the Supplementary Material on pages 213 to 220. It is first necessary to decide whether everyone in the group wishes to study all three stages which are treated in detail, or whether some prefer to study the two most relevant to their current work (two is surely the minimum, given the range of development found in any one age group). The summary of stages on page 89 may help to decide this point.

There are several possible ways of proceeding to accommodate different preferences and interests. Make every effort to allow teachers to study what they like in the way they like. Unless everyone decides for the same thing it will be necessary to form into smaller groups of those studying the same stages.

With reference to each stage there are points for discussion which

are best considered before going on to look at another stage. *Don't hurry the discussion*, for the purpose of it is to

- (a) give teachers a chance to draw on their own ideas and try to link their own experience to the description given by Piaget,
- (b) reveal misunderstanding, in which case parts of the text should be re-read,
- (c) allow those who do not agree with Piaget to give their views and arguments, which is important in preventing the feeling that the teachers are being 'sold' Piaget.

Summary of development and appropriate activities

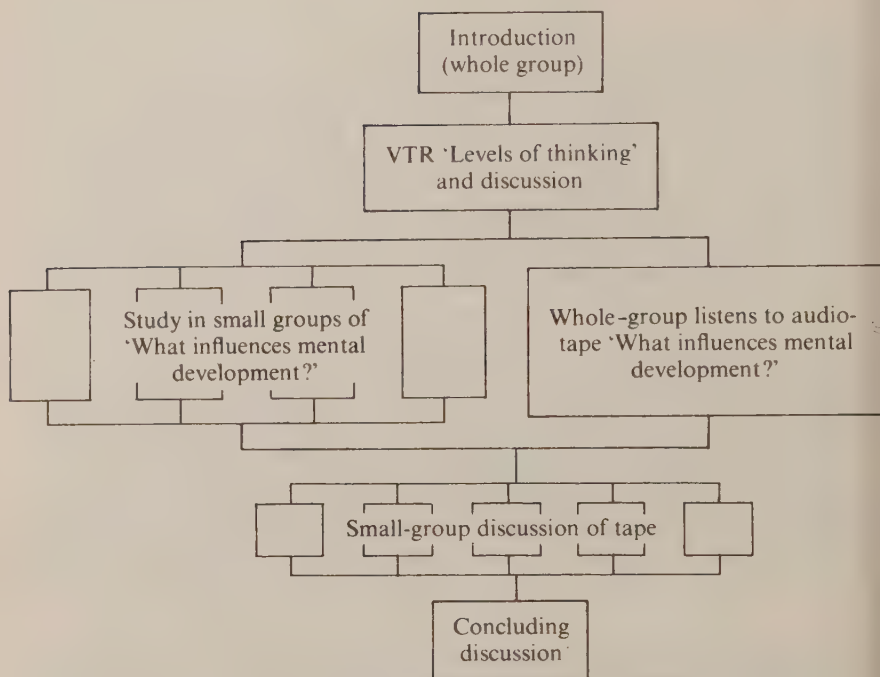
Here is opportunity to remind teachers that the purpose of studying children's development in thinking is to help in providing appropriate learning experiences. As mentioned on page 91 the selection and adaptation of activities is treated in more detail in the theme 'Making Decisions about the Learning Environment', but the summary on page 92 shows some of the general conclusions about activities drawn from the study of the characteristics of thought at the various stages.

In preparation for the next topic ask teachers to read the transcript of the VCR 'Levels of thinking' (pages 93 to 102). What inferences would they draw about the children's levels of thinking from the evidence of what is said? It will be useful to look at the experience of viewing the VCR against this background.

Topic 4: Development in Thinking

This topic is closely linked with the previous one and the procedure adopted may be affected by the extent to which teachers have shown a willingness to come to grips with interpreting children's behaviour in terms of certain ways of thinking. If there is evident interest in this analysis and willingness to discuss the relevance of Piaget's framework it may be worth while to look first at the evidence which the transcript of the VCR provides before viewing the video-tape 'Level of thinking'. On the other hand teachers may feel they want to see the action before talking about it, in which case the discussion points suggested here could be introduced after the viewing.

The topic divides fairly evenly into two parts, the first centred round the VCR, the second round the subject 'What influences mental development?' and the audio-tape on this subject. Possible procedures are indicated in the flow diagram:



The objectives of this topic are:

- 1 To identify evidence in children's behaviour which indicates the stages of development reached in their thinking,
- 2 To recognize some of the factors influencing development.

Materials required

Raising Questions, pages 93 to 106

Tape recorder

Cassette 2, side 1, sequence entitled 'What influences mental development?'

Video-tape player and TV monitor

VCR 2, sequence entitled 'Levels of thinking'

Suggestions

Introduction

The video-taped sequences give opportunity to discuss the kind of evidence which can be used to draw inferences about stages of mental development. If teachers have already read the transcript, ask if they

feel able to make any comment on the children's thinking from the evidence this provides. If so the points for discussion suggested below could be used before the VCR is viewed. But if there is reluctance to talk about interpreting behaviour until they have seen what the children do then introduce the VCR briefly as on page 93 and use the discussion points afterwards.

VCR 'Levels of thinking'

The transcript is on pages 93 to 102. It is best not to try to follow this whilst viewing but use it for discussion. The tape could be stopped after each sequence for points related to that sequence to be discussed, but since the contrast between behaviours at different stages often helps to illuminate any one stage it is worth while to see all the sequences before discussing and perhaps then to review them one at a time.

Points for discussion

It is tempting to try to 'explain' the children's reactions in terms of the materials available or the teachers' behaviour, but, without denying the relevance of these things, we are concerned here with how the children behave in these particular circumstances. So try to steer the discussion towards *describing* and *understanding* the children's thinking rather than *explaining* the reason for it.

- (a) The fact that Neil and Simon raised the board to a horizontal position above the table was suggested in the commentary as evidence of not thinking ahead to envisage the result of an action. Is this interpretation valid? What other evidence in their behaviour is there of pre-operational thinking? What evidence is there to suggest a different level of thinking?
- (b) At the end of the sequence on David and June and the eggs, June jumps to the conclusion that one of the eggs is hard-boiled because it sinks. Can anything be inferred about her reasoning from this? Note that she also observes inaccurately which one it is that sinks.
- (c) The commentary draws the conclusion that Aidan and Jane are concrete operational thinkers. Is Aidan's insistence upon moving the peg up in fours consistent with this? What inference can be drawn from the fact that they rolled each ball only once?
- (d) Yolanda and Malbindar may be aware of the need to roll each ball more than once, but is this sufficient evidence to support the conclusion that they are capable of formal operational thinking?
- (e) Contrast Deidre and Allyson's discussion of conclusions about the eggs (page 101) with June and David's (pages 95 and 96). What aspects of more advanced thinking show in Deidre and Allyson's behaviour? Note particularly that June decided the egg which sunk must be hard-boiled whilst the two other girls agreed that it was the raw egg which sank.

What influences mental development?

We now turn from the description of different ways of thinking to the question of how thinking develops from one way to another. This is introduced on page 102. The section 'What influences mental development?' can be read or heard on tape. If all wish to listen then the group will stay as a whole for this and break afterwards into small groups for discussion. However, if some wish to read, break into small groups to do this and continue into the small-group discussion. The transcript is on pages 102 to 105.

Small-group discussion of tape

The points for discussion suggested on page 105 and 106 pick up some of the main issues. It is important that these particular points are discussed but teachers should be encouraged to range widely around them and to add other points. It may be useful to reread certain parts of the transcript to sort out ideas about 'learning and development' or the two kinds of experience with objects, for example.

Concluding discussion

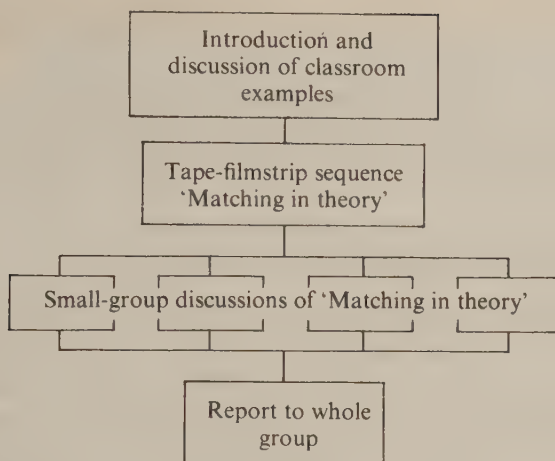
Bring the whole group together to share

- (a) points which were not understood about the influences on mental development,
- (b) points about which there was disagreement,
- (c) other points which were omitted and should have been included,
- (d) examples from their own experience which illustrate either the 'penny dropping' kind of accommodation or some other aspect of development.

Topic 5: Matching in theory

The theoretical nature of parts of this topic may mean that for some groups it could confuse rather than illuminate. *If a leader feels it is unsuitable at this point then it is best to proceed to topic 6 and bring in aspects of theory later.* The main item in this topic is the tape-filmstrip sequence 'Matching in theory'. This attempts to build up a model of what 'matching' means in terms of teachers gathering and using information about children. It may seem too divorced from reality unless its relevance to particular problems with particular children is appreciated. This is attempted through the introductory discussion (pages 106 to 108) and the application to a particular case following the tape-filmstrip presentation. These parts of the topic therefore play a vital role in giving point to the more theoretical section.

A suggested procedure is outlined in the flow diagram.



The objectives of this topic are:

- 1 *Further appreciation of the reasons for matching.*
- 2 *Recognition of the role of gathering information and decision making in the matching process.*

Materials required

Raising Questions, pages 106 to 116

Filmstrip

Filmstrip 5 and cassette 2, side 1, sequence entitled 'Matching in theory'

Tape recorder

Filmstrip projector and screen.

Suggestions

Introduction

The example, on page 106, shows how one teacher intuitively fits her approach to children to their individual characteristics. Read through it aloud to the whole group. Probably most will agree that they try to do the same kind of thing. So it will be worth while to say that the purpose in discussing matching and bringing the process to a conscious level is so that we might be able to carry it out more effectively and in more areas of children's development.

Thus the questions to raise about the teacher's different approaches to her children which we glimpse on page 106 are such as:

- how did she come to decide to treat them differently and not all in the same way?

- how did she find out what was the best way to approach each child?
- what does 'best' mean in this context?

Summarise the discussion and go through the arguments in favour of matching (pages 107 and 108). Emphasize that 'matching' implies experiences which extend children's thinking rather than keeping it just at the same level.

Tape-filmstrip sequence 'Matching in theory'

The transcript is on pages 108 to 114. Several of the diagrams shown in the sequence are reproduced for reference during discussion afterwards.

Teachers may well wish to go over points again before feeling able to discuss, so it is best to break into small groups where this can be done when they feel ready.

Small-group discussion of 'Matching in theory'

Ask teachers to consider the two questions on page 114. It is hoped that they will see the relevance to the situation described at the beginning of the topic in that the teacher would probably not have found straight away the most effective way to encourage particular children; she would have tried one approach to Brian, for example, noticed the effect, and if not satisfied changed it in the light of the information about its effect. So she is:

- making a decision,
- acting on it to approach him in a certain way (part of his learning environment),
- finding out about his reaction,
- making a further decision . . . and so on.

After collecting general reactions to the model, the discussions should focus upon the two aspects suggested in 1 and 2 on page 114.

The example about Martin is given to provide a focus for getting down to details on these two aspects of the matching process, but it should not be allowed to inhibit a more wide ranging discussion.

On the question 1 it is important for teachers to realize that they do make decisions about a wide range of features of the learning environment in the classroom. To recognize this they should be encouraged to make a list as suggested on page 116.

Examples of items which teachers have written are:

- Choice of method of approaching a subject
- Whole class teaching, individual, or groups
- Time spent on each stage of learning
- Materials used

Providing work of the right level and interest
 Expectations of the child
 Variation in time given to complete work

These items are at about the right level of generality—a problem which often inhibits teachers from starting to write anything down.

If more specific points are made, e.g.:

Whether the children make a written record on their work,
 Whether they work in the groups I choose or they choose,

then the list would be too long by the time many aspects were covered in this way.

If there are problems about reluctance to write, try

- giving some examples,
- suggesting they discuss and put down first the points on which they agree adding individual contributions or modifications later.

On the question 2 the main point is to work from what a teacher knows about a child, or can readily discover, to discuss what it is *desirable* to know in order to have a worthwhile basis for making decisions. Again encourage teachers to *write* down their ideas.

N.B. A similar activity is included in Topic 2 of Theme A: 'Making and Recording Observations about Children'. If the teachers have already studied that theme they could compare their ideas now with their previous ones. Examples given there of responses given by teachers are:

intellectual level, personality, attitudes, maturity, self-confidence, interests
 personality—introspective or extrovert, level of development reached, previous experience, special interests, speed of learning, attitude, motor development.

Reporting to whole group

Bring the whole group together to exchange briefly ideas they have put down. But more important questions are probably

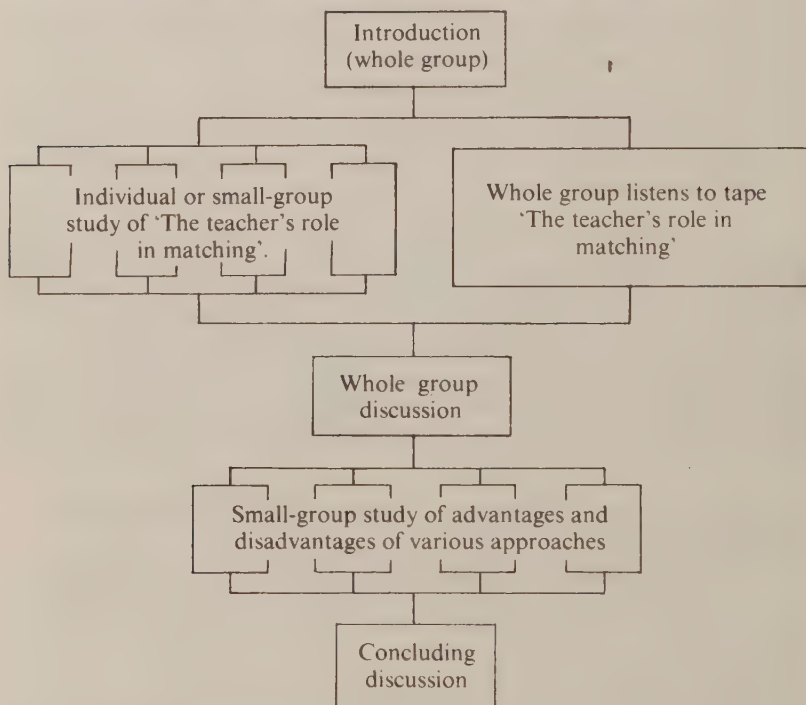
- do they feel the analysis of the matching process is worth while, or is it something best left at the level of intuition?
- what parts of the analysis have been felt most helpful and what extensions in the study of the subject would be welcomed?

Topic 6: Matching in practice

Bringing the discussion of matching to the practical level raises many questions about approaches to providing learning environments which

are suited to individual pupils. In this topic we examine various approaches in relation to the degree of matching they allow. The more detailed discussion of different factors in the learning environment—organization, the adaptation of activities, the teacher's role, pupils' choice—is the subject of Theme C: 'Making Decisions about the Learning Environment'.

The section on 'The teacher's role in matching' can be read or heard, so the procedure depends on teachers' preferences in this matter. The flow diagram gives some suggestions for organizing the topic.



The objectives of this topic are:

- 1 *Appreciation that teachers can, in their decisions, only approximate to matching.*
- 2 *Recognition of the advantages and disadvantages for matching of different approaches to putting it into practice.*

Materials required

Raising Questions, pages 116 to 123

Tape recorder

Cassette 2, side 1, sequence entitled 'The teacher's role in matching'.

Suggestions

Introduction

Although we are looking at practical approaches to matching in this topic, we cannot give attention to all the aspects and details of class organization (which are the subject of a separate theme). Set the scene for this discussion by looking at page 117 and the kinds of question raised there.

Ask for preferences as to listening or reading the section 'The teacher's role in matching' and organize accordingly.

The teacher's role in matching

The transcript is on pages 117 to 120. It can be studied privately, in small groups or heard by the group as a whole. If small groups are formed it is preferable to come together after studying the section for a brief whole-group discussion.

Whole-group discussion

- 1 The purpose of this discussion is to exchange reactions about the topic and to prepare for subsequent small-group work.
- 2 The main messages from the tape are:
 - (a) the teacher's role is vital but nevertheless she cannot be certain that her decisions will be the best ones,
 - (b) the uncertainty in the matching process means that no one approach can be 'right', the field is open for a variety of approaches which all have some advantages and some disadvantages,
 - (c) pupils themselves have a part to play in matching, but exactly what is the role of pupil choice is one of the most thorny issues. (This will no doubt enter into later discussions quite prominently)

Ask for comments on these points and any others the teachers wish to raise.

- 3 In preparation for small-group discussions of the advantages and disadvantages of various approaches read through the four quotations (pages 120 and 122) to introduce four approaches.
- 4 Which other approaches would the group also like to include? Collect suggestions, making sure that they are distinctly different from the four already included. Where the four approaches are characterized briefly on page 122 any additional ones should be added and written in as number 5, 6, etc. so that they can be included in the later discussion and summary table.
- 5 Look at the table on page 123. The numbers across the columns

refer to the approaches 1–4, and others if added. Down the side are aspects relating to children's learning. The ones written in are based on teachers' past responses to considering what should be taken into account when making decisions about children's learning environments (see page 116). More rows should be added when teachers draw up their own tables if they feel important aspects have been omitted.

- 6 One of the products of the small-group discussions should be to try to fill in the table and to see if conclusions can be drawn as to the approaches which have more of the advantages and least disadvantages in providing for matching.
- 7 When teachers are clear about their task and its purpose, break into small groups.

Small-group study of advantages and disadvantages of various approaches

The method of recording the results of discussion about each approach should be agreed within each group.

One group—probably the one to have finished the table first—might be asked to present their findings to the others, showing the results in their table on a blackboard or overhead projector.

Concluding discussion

Open the whole-group discussion by finding out the measure of agreement between the groups in their opinions about how well each approach caters for different variations between children. As suggested, ask one group to present its findings and invite the others to comment.

Consensus is not, of course, the aim, but disagreements should be followed up even if not resolved.

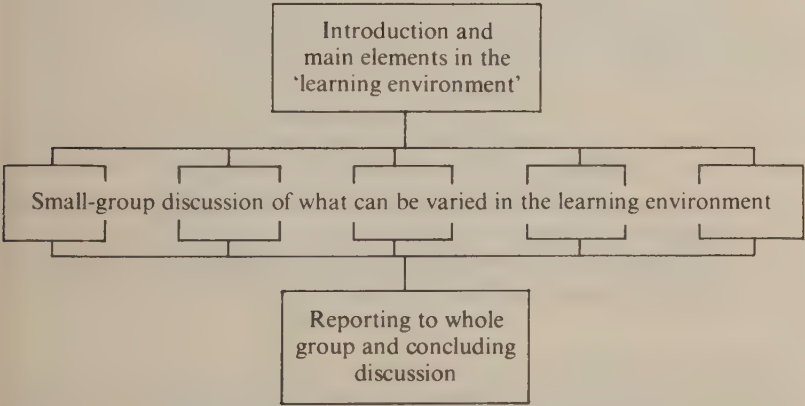
Then look at the 'ratings' of various approaches. Is it possible, is it useful, to conclude from the analysis that one approach caters better for matching than another? What other factors should be taken into account?

In ending the theme by raising questions rather than arriving at answers it may seem that we have not gone very far. But the solution to teachers' problems have to be sought in their own thinking about their own classrooms; studying the theme will thus have achieved some of its purpose if it has given teachers new ways of thinking about these problems.

Theme C: Making Decisions about the Learning Environment

Topic 1: What can be varied?

In this topic the child's learning environment is discussed as a whole to provide the context for the later discussion of certain separate parts of it. There can be considerable flexibility in procedure to suit a particular group since there are no visual aids to be studied by the group as a whole. In some cases it may be best to divide into small groups immediately after a very brief introduction, whilst in others the whole subject of the 'learning environment' would be better tackled by the group as a whole. The outline below suggests a compromise between these two, where the concept of 'learning environment' is introduced to the whole group and the more detailed discussion follows in small groups.



The objectives of this topic are:

- 1 *Appreciation of the features in the surroundings which affect a child's learning and of the different conditions which are needed to cater for variations between children.*
- 2 *Recognition of the features of the learning environment which a teacher can vary.*

Materials required

Raising Questions, pages 124 to 127

Suggestions

Introduction

The second of the Introductory Topics may well have provided some basis for discussion of factors which influence children's learning. The video-tape 'Some matches, some mismatches' will probably have led to the identification of many different factors of the kind already listed on pages [8] and [9].

In this theme we are concerned with those factors which are external to the child (ones which relate to the intellectual, social and personal development are considered in Theme B: 'Children's Development and Learning').

The first main issue is whether it is necessary for there to be variations in the learning environment from one child to another. That is, it is one thing to agree that a variety of different factors does influence learning, but it is another argument as to whether these factors should be the same or varied for different children. The cases of *Nigel and Jill* are brought in to open up this argument.

The section on Nigel and Jill is brief and it may be helpful for the leader to read it out aloud for the group to consider together. Teachers will be able to add other examples, no doubt. Questions which might be discussed are

- is there a good case for treating Nigel and Jill differently?
- in what respects would there be variation between their experiences? (e.g. in the teacher's approach? in activities?)
- in what respects would it be best to treat them in the same way despite their differences?
- can we generalize from these and other examples to say that all children require individual treatment to some extent?

'Learning Environment'

This concept is an important one for the appreciation of this theme and it is worth spending time on it, though without labouring it, at the start.

As the description on page 125 indicates the phrase 'learning environment' is being taken to include all the objects, people and circumstances which contribute to the child's learning, either in a positive or a negative way. The few brief comments of children given show how many of these external factors have an impact on the child's reaction to intended learning experiences in the classroom.

The diagram on page 126 is an attempt to represent the child as subject to a number of overlapping influences. The diagram here is a more general one than the one given on page 109 in Theme B: 'Children's Development and Learning', since in the latter case the

focus was on the child *in school*, so that the home and out of school influences were considered as more remote than features and conditions of the classroom. The more general diagram is explained on page 126 and teachers can be invited to criticize, modify or add to it.

From this general picture we turn to consider one part of the child's learning environment, within the classroom, and the next task is to identify the more influential aspects of it.

Teachers might break into smaller groups to carry out the work suggested on pages 126 and 127. Before breaking make sure that teachers are clear that the first thing to do is to consider *all* factors, whether or not anything can be done about them. After that they can decide which ones can be varied to suit individual children, and the point of the activity on page 127 is to identify in what ways the features or conditions which are under the teacher's control can be varied.

Small-group discussion of what can be varied in the learning environment

Teachers may be reluctant to write things down, but they should be encouraged to do so, for the sake of their own thinking, to give them a record for possible later reference, and as a basis for reporting to the whole group. Try suggesting discussion within the group before writing, or having one rapporteur, or other means of ensuring that thoughts are clarified and put down on paper.

Examples of items which teachers have put down on page 127 are:

kinds of materials and activities, whether or not they can choose who they work with, whether they work in a group or as a whole class or alone, the time they spend on an activity, what is expected of them, how much praise or other encouragement they get, how much supervision or direction: . . .

When a group has completed a list to their satisfaction, they can try to decide which of their items can be varied and within what range, by the teacher. The suggested table on page 127 could be used as a pattern, or teachers might prefer to devise their own way of showing variations without the restriction of defining a range or dimension of variation.

Reporting to whole group

Ideas of different groups about factors in the classroom affecting a child's learning can be exchanged by one group's spokesman reporting its list and others adding to it or questioning items included. The same can be done with the 'aspects which can be varied'. It should be appreciated that the exchange of views is not for the purpose of arriving at a consensus, but to increase the range of different points of view

which are expressed. Indeed if there is almost 100% agreement between groups there is little point in the formality of exchanging ideas.

Teachers should be encouraged to give concrete examples to support their views about what can be done, or cannot be done, in the classroom, especially where these views are contested.

Concluding discussion

The purpose of this should be to move from the level of general discussion towards the teachers' own classrooms. Some may be prepared to talk about what they vary in their own classrooms and to give reasons for not varying other factors which have been suggested as variable. Other teachers will prefer to examine their own practice more privately. In either case suggest that the list of 'what can be varied' is used as a way of reviewing what is done and perhaps reconsidering what might be done.

Topic 2: Classroom organization and constraints

This topic falls naturally into two parts which could form the subjects of two separate sessions; on physical organization and on organization of activities. In the first part there is a series of case-studies of organization of four classrooms, three of them presented through tape-filmstrip sequences. Depending on the size and interests of the group it may be preferable to break for discussion after each case-study, rather than to view all of them (which takes about 20 minutes) before small-group discussion. In either case it will be helpful to bring the discussion of organization to a close in a whole-group discussion before proceeding to the second part, on the organization of activities.

The objectives of this topic are:

- 1 Recognition of the forms of organization which seem best suited to children's achievement of a variety of goals.*
- 2 Appreciation of the value of variety and flexibility in organization in providing for different experiences and the achievement of different goals.*

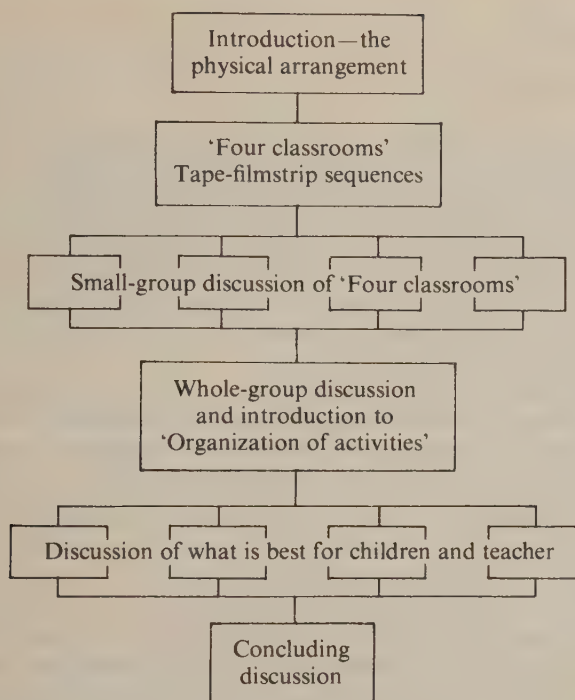
Materials required

Raising Questions, pages 127 to 143

Slide projector and screen

Cassette recorder

Filmstrip 4 and cassette 2, side 2, sequence on 'Four Classrooms'.



Suggestions

Introduction

In this topic we are concerned with decisions made by the teacher about classroom organization; in the first place the physical organization of furniture and resources, and in the second place methods of organizing activities. These are not, of course, easily separated, for the organization of physical objects is decided so as to facilitate the chosen way of working, within the constraints imposed by the classroom architecture and furniture—or is it? This has to be explored rather than accepted categorically. What can we tell from the class organization about the experiences of the children? Does the physical organization of a class tell one anything about the teacher's priorities or values in education?

The statements on page 128 suggest possible reasons for various kinds of organization but whether there is the implied connection between class arrangement and children's experience is something to be explored. We start by looking at arrangements in four classrooms and at the reasons the teachers gave for these arrangements. Later it may be helpful to apply the emerging conclusions to the classrooms of teachers in the group.

Four classrooms

(a) *Infants teacher*

Show first frame of school building, whilst giving the following detail. A large primary school (about 450 children), in an urban setting, about 25% immigrant children; built in early 1900s on two floors, now occupied by infants on the ground floor, juniors on the first floor. On both floors the classrooms all open onto a large hall which has to be a main thoroughfare. Show the first frame of classroom and turn on the tape. Change frames as indicated in the transcript on pages 128 to 132.

The transcript is provided for teachers as a basis for discussion after the sequence, not to follow during it.

If you and the group prefer to discuss this sequence straight away after it, there are points on pages 132 and 133 which can be used as a start. However, you may decide to continue to see the other cases and then discuss the points of difference and similarity which are highlighted by comparing them.

(b) *Junior teacher (1)*

Show first frame of the building of this school whilst saying briefly that it was built at much the same time as the first one we have seen, in an identical pattern, and also has an Infants' department below with Juniors above. The class we see is that of one of the teachers of fourth year juniors. Show the first frame of the classroom and turn on the tape and proceed as before. The transcript is on pages 133 to 137.

If the sequence is discussed immediately afterwards then the points on page 137 can be used as a start. The conversation with *Junior teacher (2)* can then be included at this point.

(c) *Junior teacher (2)*

There is *no tape* for Junior teacher (2) (due to the background noises when the conversation was recorded) so it may be helpful to read the conversation aloud.

Where it has been decided to see all the tape-filmstrip sequences before much discussion, proceed from the end of Junior teacher (1) to Junior teacher (3) which begins on page 139.

(d) *Junior teacher (3)*

With the first slide on the screen explain that we are back in the same school as the infants' teacher seen earlier. Turn on the tape when the first classroom frame is shown. The transcript is on pages 139 to 143.

Small-group discussion of 'Four classrooms'

Points which might be discussed after the tape-filmstrip sequences are, in each case:

- does the physical arrangement seem to reflect the teacher's ideas as to the kinds of experiences children should have at school?
- is what is seen consistent with the intentions which the teacher expressed when she spoke about the way she organizes the room?
- look at Junior teacher (2) (not on tape), who would like to be able to organize things differently—are the constraints which she sees as preventing her working in groups as insurmountable as she considers them to be?

After drawing together general points arising from these case-studies their application to other classrooms might be considered, as suggested in Discussion Points 1 and 2 on page 143.

In one group a very useful study was made as a follow up when one teacher described the problems of organization she had in a 'difficult' room. She drew a plan of her room showing the positions of the various pieces of furniture and equipment and explained her reasons for arranging things as they then were. Other members of the group suggested that she could try alternative arrangements which they thought would achieve her intended purposes better. Some of the proposed changes challenged things she had regarded as 'fixed' e.g., the position of her own desk near to the blackboard. She found her reasons for this particular part of the arrangement did not stand up to close examination and the decision to change this opened up many more possibilities for rearranging the rest of the room more conveniently for everyone.

Whole-group discussion

Bring together the main points from the small-group discussions, perhaps by asking one group to review their responses to the points on page 143. One thing which should be mentioned if it has not already been covered is the inadvisability of jumping to conclusions about a teacher's educational values from the appearance, only, of her classroom. A great deal can be gleaned from the look of a room, but appearances can be deceptive, in this as in other things. An informally arranged room can be used formally; an arrangement provides the *potential* for certain kinds of experience by the pupils but doesn't ensure them in practice.

Introduction to 'Organization of Activities'

As for the physical organization the subject of organization of activities

is considered in terms of freedom and constraints for experiences of different kinds. It is necessary to start from the assumption that no *one* form of organization is 'right' for everything and we are working towards a balance of experiences appropriate to the range of goals.

Read through page 144, making clear that methods A, B and C are not proposed as distinct or special in any way, but only as representative of points along a continuum of different methods from the highly teacher-directed to the highly child-centred. Most teachers are likely to use methods at several different points along the continuum in any one day.

It is necessary to be clear about what is meant by methods A, B and C even though there is no intention to 'label' a teacher as one or another.

Method A is exemplified by Junior teacher (1) above.

Method B is illustrated by the teacher who chose the subject of 'The Zoo' as a topic for the term for the whole class. Within this different animals were studied by different groups of children who found out about their countries of origin, life cycles, habitat etc. In art and craft they modelled or painted their animals, learned poems about them, and of course went to see them at the zoo. (A further example is given on pages 227 to 229.)

Method C involves work of the kind described in the Supplementary Material, page 226.

Before breaking into small groups look through pages 145 and 146 to explain the purpose of the discussion and tasks suggested. The first task is to discuss the appropriateness of the three methods to achieving a wide range of goals of education. This provides an overall context so that the more narrow focus of the second task will not appear to ignore important aspects of the children's experience.

Teachers who have not studied Theme A: 'Making and Recording Observations about Children' may need time to consider the goals of learning science which are proposed on pages 181 to 186. The table on page 146 can be completed in any consistent way decided by each group; for instance they may decide to rank each method in terms of its effectiveness for achieving the goals (** for most effective, * for second and * for least effective) or they may consider that a tick under the most effective is all that is required.

Small-group discussion of what is best for the children and the teacher

The value of teachers filling in tables as suggested has been mentioned before. They are often reluctant to do so but will find it helps in summarizing a discussion. The pressure to write things down should not be so evident that teachers see the filling of the table as the

whole purpose, but rather as a way of making sure that the discussion has a focus and a product.

When the tables suggested on pages 145 and 146 have been filled in and the discussion about them completed, groups can go on to discuss the advantages and disadvantages of the three methods from the teacher's point of view, starting by reading the section on pages 147 and 148.

Concluding discussion

Agreeing the details with respect to the table on page 145 is less important than drawing out points which are relevant to a 'balance' of appropriate teaching methods.

Is any method *always* the most appropriate?

Is any method *always* the least appropriate?

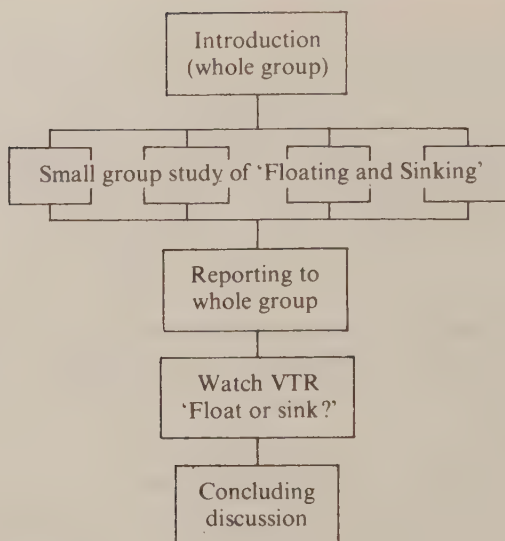
Can we say that in practice the most appropriate method is always used? At the more detailed level of the goals on page 146 the same questions can be asked. Whether the most appropriate method can be used depends upon the teacher, of course. Since method C is evidently important for many of the goals of learning science the passage on page 147, the examples given in the Supplementary Material (pages 224 to 226) and the reference all focus on various ways of developing this way of working. Teachers can study these privately, having hopefully appreciated that although it is an important way of working it is not the only one which is relevant for science activities nor for other aspects of children's education.

Topic 3: Making decisions about activities

The order of procedure outlined on page 62 suggests a start in terms of considering at first hand particular activities relating to 'floating and sinking'. It helps the discussion if teachers take part in the activities, use the objects, and discuss the problems and potential in them for enabling children to form various ideas. This experience before watching the video-tape will hopefully provide a context for interpreting the behaviour of the children recorded.

The objective of this topic is:

Appreciation of the variety of abilities and ideas which a particular kind of activity can help develop, and how the progress which can be made depends upon the abilities and ideas which children already have.



Materials required

Raising Questions, pages 148 to 158

Containers for water—bowls or small aquarium tanks

Objects for floating and sinking, including plasticine, bottle tops, buttons, aluminium foil, rubber and plastic objects, small and large pieces of wood, coins and large pieces of metal.

Video-cassette player and TV monitor.

VCR 2, sequence entitled 'Float or sink?'

Suggestions

Introduction

Only a brief introduction is necessary to make clear that 'floating and sinking' activities are being considered as an example, for the reasons given on page 148, and there is no intention that any of the investigations suggested should necessarily be carried out by children in this particular way. The emerging general principles about the variety of goals which an activity can help children to achieve and the importance of building in their existing ideas will be the things which can be directly applied in the classroom.

Arrange groups of three or so, four at the greatest, to work with one set of materials. Ask teachers to look at page 148 and consider how many of those suggestions could be carried out with the materials at hand. As they try some of the activities, they should be thinking of the points raised on page 149, i.e. what ideas and abilities can be developed?

The ideas and abilities suggested on page 149 came from the items in the check-lists, and teachers may like to refer to pages 181 to 186 for a quick reference to the meaning of the terms used.

The main task of the group work is to proceed to page 151 and consider the various activities in more detail, and at this point teachers may find it of help to carry out each activity as it is discussed.

Small-group study of 'Floating and Sinking'

A possible procedure for this has been outlined above. Encourage teachers to challenge, change and add to the suggested list of ideas and abilities to which floating and sinking activities in general contribute. Looking at the check-list items may suggest some more goals which should be included, but there is no need to keep to these only. The more detailed study of particular investigations required to complete the table indicated on page 151 requires further thought about each activity. Any additions made to those given on page 149 should be added to this table. It certainly helps if teachers carry out each one at the time. Filling in this kind of table is difficult, as mentioned on page 150, but worth attempting for the sake of the issues which are raised. Teachers might find various ways of indicating priorities in the table.

Reporting to whole group

The point of completing the table is not to arrive at a set of 'answers' but instead an awareness of the inter-relation of activities and goals. However discussion of the agreement between groups provides a good starting point. One group could present their table to the others, who comment where there is disagreement. It is then useful to discuss:

- the frequency of marks in each column,
- are there some columns with very few/very many marks?
- the frequency of marks in each row,
- are some activities potentially more effective for developing some skills and abilities than other activities?
- does the meaning of a mark on the table depend in all cases on how the activity is carried out, the teacher's role and so on?

VCR 'Float or Sink?'

Having looked at the potential in various activities for development of different ideas we now turn to the question of what is appropriate for particular children. The subject thus shifts from the activities to the ideas which children have about them.

The transcript of the VCR is on pages 150 to 157. Some groups might find it useful to read through the transcripts before viewing the tape,

looking for clues to the children's ideas from what they say. Others may prefer to watch first and use the transcript afterwards to find evidence to support points made in discussion.

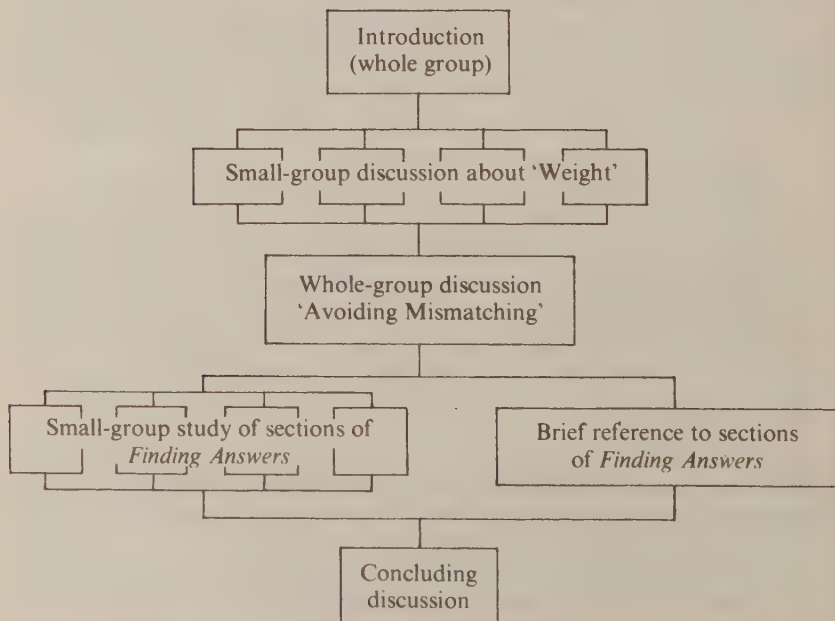
Discussion

Points for discussion are given on pages 157 and 158. Teachers are invited to challenge suggestions made about the four children; when they do so they should supply evidence from the transcript to support their argument.

The subject of children's intellectual development links here with the Theme B: 'Children's Development and Learning'; some may find it useful to read pages 213 to 220 before the next topic.

Topic 4: Adapting to levels of thinking

As the various ideas here are presented without audio-visual aids, there is considerable flexibility in procedure. It is best to follow a group's preferences for discussing the proposed ideas in small groups or as one whole group, and whether to introduce the ideas to the group or to leave them to read sections privately. Thus the following suggestions are extremely tentative and should be applied only where they coincide with the ways in which a particular group likes to interact.



Alternative ways of studying sections of *Finding Answers* are suggested, depending on the interest of the group and the time available for going into detail about particular concepts.

The objectives of this topic are:

- 1 *Some idea of what it is about activities which make them suitable for children at different stages of development.*
- 2 *Ability to analyse activities so as to select and adapt them to avoid mismatching to children's development.*

Materials required

Raising Questions, pages 159 to 164.

Finding Answers, pages 72-121

Suggestions

Introduction

The topic makes suggestions for approaching the difficult process of deciding how to select or adapt activities to suit the developmental level of individual children. Many activities, as has been seen in the last topic, can be varied and approached in different ways; we are tackling here the problem of deciding when one or another way is best for an individual.

Draw attention to the two reservations made on page 159; these try to prevent us from being too narrow in the range of aspects of the child which are considered, or too definite about our decision.

Explain that we are making a start by considering the most general guide-lines and therefore first look at (or review, if this section has already been studied by the group) page 92. The guiding principle in relating activities to development there is the same one which we will apply to more detailed activities, that children's experiences should be such that they can be understood with the ideas the children already have but at the same time challenge the children to extend and elaborate these ideas.

Turning to more specific points about activities, read through the questions on page 160 and the introduction to their application to children's ideas about weight.

Prepare teachers for working in small groups to draw up and complete a table as on page 161.

Small-group discussions about 'Weight'

Suggest that teachers look quickly through the activities listed on page and then turn to page 161 to consider the children's ideas listed there. More items should be added to this list in discussion, as it is not intended to be complete.

Then return to page 160 and discuss the demands of each activity in terms of pre-requisite ideas—those which children must already have to benefit from an activity—and in terms of potential for developing ideas. The ideas can be recorded in the two columns using the letters A, B... as labels.

Whole-group discussion

It will be useful to review and compare the results of different groups, for the variation will reveal the difficulties of this kind of exercise. As usual this can be done by one group reporting its findings (writing the table on a board or overhead projector transparency) whilst other groups comment where there is disagreement.

The next question is then how to use the results of such an analysis and we turn to the section 'Application to avoiding mismatching'. Study the section under this heading on pages 162 and 163.

Introduce the sections in *Finding Answers* by looking first at pages 81 and 82 where activities relating to weight are roughly 'matched' with developing ideas. The analysis in terms of 'prerequisites' and 'development' has been used here but the outcome presented as activities related to ideas rather than ideas related to activities (as on page 161). Discuss the correspondence between teachers' ideas on page 81 and the table on pages 81 and 82 (*Finding Answers*).

The reason for inverting the table and presenting it as on pages 81 and 82 is that it facilitates starting from the child's ideas and matching activities to the child rather than vice versa.

Study of sections in *Finding Answers*

At this point some teachers may wish to study the sections in *Finding Answers* which have been treated in the same way as 'Weight'. They are as follows:

Grouping and Classifying	—pages 72–78
Length	—pages 83–89
Area	—pages 90–98
Time	—pages 99–109
Volume	—pages 110–118
Life cycle	—pages 122–124
Cause and effect	—pages 119–121

Others may prefer at this point just to look briefly at these sections, but leave more detailed reading for private study.

Concluding discussion

The guide-lines which are provided in *Finding Answers* relate to selecting activities which may be a match and avoiding ones which are likely to be a mismatch. But in some cases it is necessary to adapt rather than select because children are working in a group, sharing an activity which may match some but not all of them. Some of the channels open in such a case are:

- to give a child additional experiences which help him to grasp ideas he needs but has not already formed.
- to guide him into a particular aspect of the overall enquiry for which he has the necessary ideas and abilities,
- to extend the activity so that it challenges children who have already achieved certain ideas; whilst others continue on aspects which help to form them.

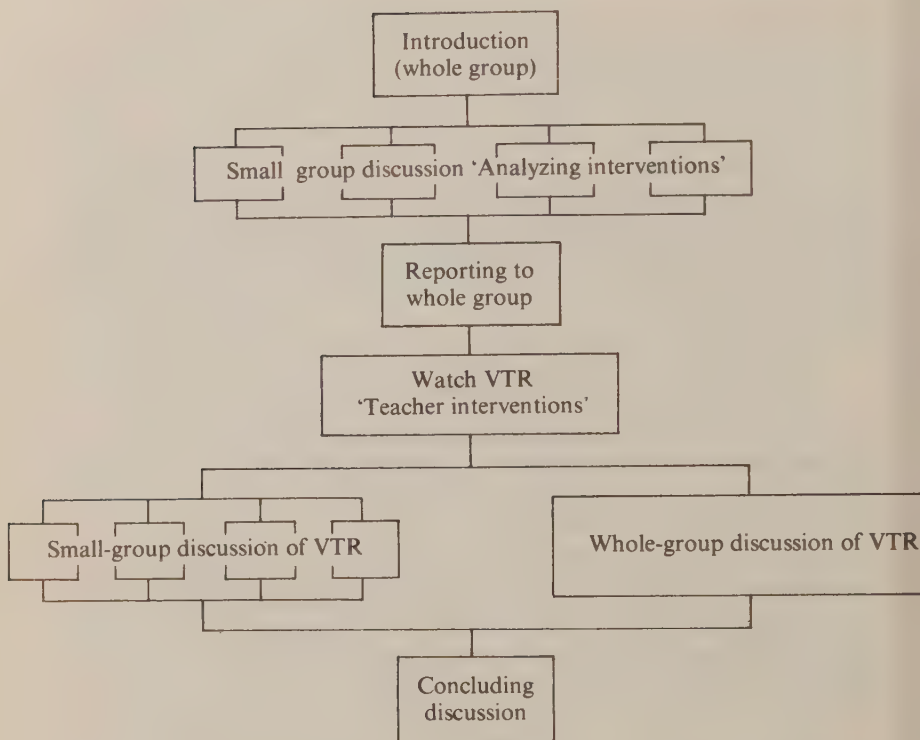
‘Floating and Sinking’ has already provided an example of how a group working together could be pursuing different aspects of the overall investigation, which challenge them at different levels. The application to other activities is a task which teachers might like to undertake as an extension to the work in this topic.

Topic 5: The teacher’s role in supporting progress

The material in this topic can be spread over two sessions if necessary, the first being mainly concerned with ‘Analyzing interventions’ and the second with the VCR on ‘Teacher interventions’. The subject of the teacher’s role generally provokes intense discussion much of which can be very fruitful; it can also become defensive or too anecdotal, so it helps to have a focus provided by the identification of actual behaviours as required on page 165. In the order of events proposed free discussion of the teacher’s role in given situations is put before the more ‘closed’ examples shown in the VCR. However if discussion of the situations on pages 165 and 166 does not get off the ground very easily it may well be worth while to go on to the VCR and return to them again later with the framework in mind suggested by the VCR.

The objective of this topic is:

Recognition of the kinds of teacher behaviour which contribute to matching and to children’s progress.



Materials required

Raising Questions, pages 164 to 174

Video-cassette player and TV monitor

VCR 2, sequence entitled 'Teacher Interventions'.

Suggestions

Introduction

This topic is linked closely with the previous one but shifts the focus from what the teacher wants to find out about the children to the way she can go about finding and using this information. As a start some of the previous discussion is recapped to provide a context for this change of focus. It is suggested, then, that the points on pages 164 and 165 are briefly reviewed at the start.

The subject of teacher interventions is then introduced through three 'problem' situations. As teachers will easily appreciate these are *not* hypothetical but are all true instances of situations teachers have faced, and similar to many others which are faced daily.

Although three are given it is not necessary for all to be considered for the points to emerge; teachers might spend varying times on each according to their interests or teaching backgrounds.

Small-group discussion 'Analysing interventions'

Ask teachers to write down some indication of what they think the teacher would do in each case. Emphasize that the focus is on what the *teacher* does, not the children, and on what she decides to do and how she comes to the decision. In this context deciding not to do anything is important and reasons for such a decision should be considered.

Reporting to whole group

Ask one group to report their ideas about what the teacher would do. When other groups have commented and compared their ideas try to draw out general points which can be written down as suggested on page 166. If there is insufficient agreement for general points to be brought out ask teachers to put down their differing ideas about behaviours which characterize good decisions.

One teacher wrote the following list:

- 1 First thing is to stop yourself saying anything, but just watch and listen (It might only take a few seconds).
- 2 Ask about what they're doing—and listen.
- 3 What is their reason for doing or proposing to do something?
- 4 What help do they think they need?
- 5 What help do you think they need?
- 6 Decide: Is (2) worth while? Is (3) a good reason for them? Can (4) be supplied? Are they able to use (5)?

Video-tape 'Teacher Interventions'

The transcript is on pages 167 to 173. The four sequences are quite short, so it is worth while seeing them all through without a break, at least for the first time. Teachers may want to review certain sections during the subsequent discussion.

Discussion of VCR (in whole group or small groups)

In addition to the points suggested on page 173 the discussion of each sequence can have the purpose of testing out the ideas proposed earlier about what actions and reactions of teachers constitute helpful interventions. e.g. In the first sequence:

Did the teacher find out what the children thought they were doing?
What is the evidence for this? ('What have you been trying to do?')

'Can you show me how you were trying to weave it?')

Was what she decided to do related to what help the children thought they needed? etc.

Where teachers previously had differing ideas about behaviours characterizing good decisions it may be best to pursue this detailed discussion of each sequence in small groups, so that earlier ideas can more easily be revised, if this is found necessary, in the light of these more concrete examples.

Concluding discussion

Draw out from previous discussions the points about teacher's behaviours which relate to making decisions

- gathering information about the situation,
- putting this in the context of the possible lines of progress which are open.

To what extent do teachers consider these to be important to deciding what action to take when a teacher intervenes to help children?

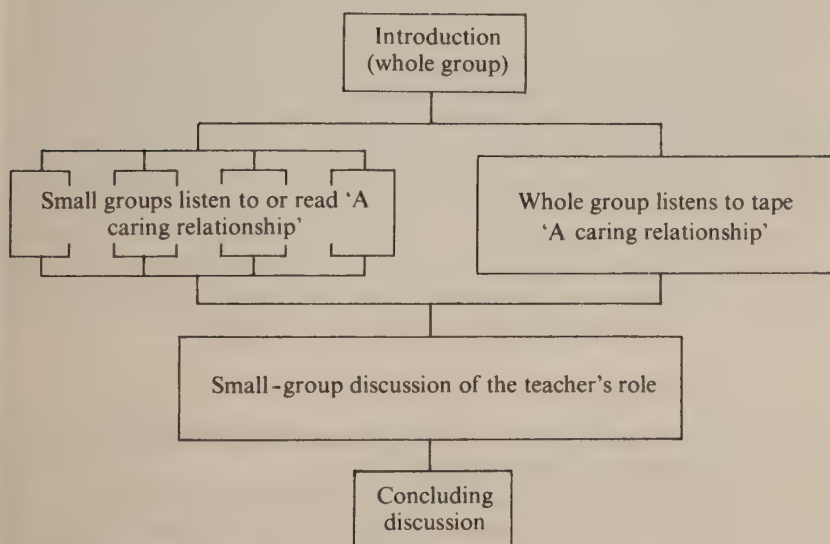
The way in which these fit into the process of 'matching' is summarized on pages 173 and 174. The flow diagram on page 174 attempts to show the continuous nature of the process of gathering and using information and indicate that each intervention is not an isolated event but part of an ongoing process of building up a picture of various aspects of a child's development. The picture is, of course, never complete, because the child is changing in response to each new situation; we therefore never reach the point of knowing where a child is and hence the gathering of new information has always to be a necessary part of each intervention, as well as the use of already accumulated information.

Note: For the next topic it is useful to have read 'Do attitudes affect learning?' on pages 67 to 69. Suggest that teachers look at these pages if they have not already done so, and when you have read it pick out the points which you think make the most suitable introduction for this particular group to the next topic.

Topic 6: The teacher's role in developing positive attitudes and personal characteristics

The subject of the teacher's role is continued in this topic where the focus turns to the effect of different kinds of teacher behaviour on the affective and emotional development of the children. There is an audio-tape which presents some ideas about the relationship between teacher

and pupil which fosters positive attitudes. The tape can be heard, in small or large groups, or read, according to the preference of the members of the group. If in small groups, the discussion which follows can continue in the same groups.



The objectives of this topic are:

- 1 Recognition that teacher behaviour influences children's attitudes.
- 2 The identification of some teacher behaviours which are likely to encourage or discourage the development of positive attitudes in children.

Materials required

Raising Questions, pages 174 to 180

Cassette recorder

Cassette 2, side 2 sequence entitled 'A Caring Relationship'

Suggestions

Introduction

We try here to come to grips with what may be behind the well-known experience of finding that some children will do almost anything for one teacher but hardly anything without reluctance for another, some are prepared to 'have a go' most of the time whilst others will not try new things unless they feel fairly sure of succeeding.

An attitude has been taken to be (see page 66) 'a preparedness to act or react in a certain way to particular people, objects or situations.'

One assumption in this topic is that a child's attitudes do affect his learning: the argument for this was covered in the section on pages 67 to 69. If there is any dispute over the importance of attitudes it may be necessary to recap some of the arguments made in that section.

A second assumption is that experiences at school, and especially the experience of relationships with teachers, affects the development of attitudes. Putting these two together leads to the conclusion that how a teacher behaves towards a child affects not only his cognitive development but also his affective development. This is summarized in the three points on page 175.

The tape 'A caring relationship' attempts to identify some features of a teacher's approach to a child which contribute to development of positive attitudes. Ask the group about preference for reading or listening to the tape and arrange small groups if necessary.

'A caring relationship'

The transcript is on pages 175 to 178. Further related material is given in the Supplementary Material (page 229).

Small-group discussion might well begin directly after the tape, starting with the points suggested on page 178 and then continuing to examine critically the general guide-lines for 'positive action' and 'behaviour to be avoided' on pages 179 and 180.

Small-group discussion of the teacher's role

The first point is an opportunity to re-examine the idea that the teacher-pupil relationship is important in the way suggested. Press for examples to be given, both by those who support this notion and those who reject it.

There is further material relevant to the second point in the Supplementary Material, which suggests that children's view of a 'good' teacher changes in some respects as children become older.

The third point is perhaps the most difficult and important one. If we foster positive attitudes by helping a child to succeed in reaching his individual goals do we make it more or less difficult for him to accept how what he has achieved compares with the achievement of others?

The discussion of these points is necessary before proceeding to the question of what kinds of teacher behaviour affect attitudes. The lists on pages 179 and 180 are not intended to be complete, but only to provide starting points for teachers to prepare their own. It is expected, then, that many of the items will be challenged and changed and that the lists will be lengthened.

Concluding discussion

Recall that the uncertainties of 'matching' apply as much to the development of attitudes as to intellectual ideas and skills. The suggested behaviours indicate, therefore, things which are worth trying, but in any particular case are subject to revision in the light of feedback continuously gathered.

If the discussion seems to have been too general the references given to sections of *Finding Answers* provide examples of their application. These sections also put the fostering of attitudes into a developmental context, in which teacher's expectations of children's attitude formation should take into account the stage which has been reached.

Match and Mismatch

Raising Questions

Fitting learning experiences in science to
development for five to thirteen year olds

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Introductory Topics

Topic 1: An overview of *Match and Mismatch*

The purpose of this topic is to give information about the aims and the nature of the materials and to survey some of the arguments in favour of 'matching', a notion which is regarded as the most important theme running through them.

The following is a transcript of the tape-filmstrip sequence which has been prepared to present information about *Match and Mismatch*.

[1] *Match and Mismatch* is about making decisions—the kinds of decision a teacher is taking almost every moment in the classroom,

- [2] about Jill's slow progress in grasping place value,
- [3] how to prevent Carol becoming discouraged when she gets the glue everywhere but where it's needed,
- [4] what to do about Oliver's motor that won't work,
- [5] how to encourage Pamela to share materials instead of keeping them all to herself,
- [6] about helping Mandy to notice what she missed before, and to try working it out again,
- [7] what to do to help Christopher who's having trouble with his model.

Taken separately these events seem small and of little importance, but a teacher's interaction with her* pupils is made up of the combined impact of such small decisions.

Match and Mismatch, which is concerned with the age range 5 to 13, is aimed at helping teachers decide about activities and approaches which are best suited to a particular child at a particular time.

- [8] We have to find out where a child is to know how to help him.

It is our conviction that these decisions should be based on knowledge of the relevant aspects of children's development. So, put simply, the materials offer teachers assistance in finding out where a child is, and starting from there.

[9] Of course this approach to teaching and learning is relevant in all areas of children's work but the project is illustrating it with

* Please note that, for convenience and consistency, we refer to the teacher as 'she' and the pupil as 'he'. It is hoped that male teachers will not be deterred by this convention.

respect to learning science. [10] No one should be troubled by the word '*science*'; its meaning is taken to be *a way of learning which involves first-hand experience, enquiry, [11] problem solving, the interpretation and communication of findings, [12] and the development of attitudes which promote this way of working.* [13] In other words it refers to the kind of activity carried out in many areas of the curriculum as well as that called '*science*' [14] The kind of science with which we are concerned probably already goes on [15] in most classrooms where children are encouraged to explore and find out for themselves [16]—what we call it is not important.

The nature of the help being offered to teachers is different from that provided by previous curriculum projects in science since it is not producing new content for science activities. [17] Very many excellent ideas and activities are already available from projects such as Science 5/13 (these books are now in many schools and most teachers' centres have them); [18] also from the Nuffield Science Projects and other publications [19]. *Match and Mismatch* and associated materials are complementary to all of these [20] and, it is hoped, will enable teachers to take greater advantage of these existing resources.

The materials aim to provide:

ideas and materials intended to help teachers use existing resources to full advantage.

They do *not* provide:

new content for science activities.

Now let's get back to the classroom and try to be more explicit about what we mean by '*finding out about children*'. [21] Here is Christopher again struggling over that model. What will his teacher do to help? She could tell him to try again or show him what to do; she could point out a book where there is something about it, or she could give him a hint but not the whole solution; she could tell him to leave it and do something else . . . there are many things she could do. But which is best for Christopher?

We can't tell unless we know Christopher. It could be that he hasn't developed certain ideas enough to work it out for himself, or to benefit from a book; it could be that he *is* capable of working it out, but lacks perseverance and calls for help before really trying for himself. It takes quite a bank of information about Christopher to know what is best. But the teacher has to react straight away; she can't depend upon finding out about Christopher at that moment, she must use what she already knows about him. [22] She knows him from observing how he gets on with other work, from seeing him at play time with other children, [23] from seeing him work with others [24] and alone, and she has looked at the product of his work. [25]

Picking up clues about Christopher from observations such as

these provides a store of information which can be drawn upon for making moment-to-moment decisions. So what we mean by 'finding out about children' is picking up evidence of their development and progress through everyday observations, as an on-going process, not through specially contrived activities or tests.

[26] Observation doesn't just mean watching or looking, and it isn't necessarily time-consuming, because it can be carried out as part of normal interaction with the children. It involves:

- [27] listening to a child and attending to what he has to say,
- [28] discussing his work or ideas with him,
- [29] noticing how he behaves with other children, and
- [30] other aspects of behaviour which help to build up a picture of a child as a person and a learner.

Once we know about a child's present ideas and ways of looking at things we are in a better position to help him through activities and approaches which match his development.

This will sound, to some, an obvious approach, but for many teachers it is not so easy to put into practice, particularly in relation to children's learning in science. [31] The project is trying to help by providing guide-lines relating to the questions:

- [32] 'What is it important to observe?' that is, what kinds of behaviour should we try to observe?
- 'How can we interpret what is observed?' that is, what meaning can we give to our observations?
- 'What activities and approaches are appropriate?' What decisions follow when certain levels of development are identified?

First the question: [33] 'What to look for?' We tackled this problem with several working groups of teachers and through their efforts produced a list of concepts, abilities and attitudes ('attributes' we can call them as a whole, for short) which are relevant to learning science. By 'relevant' to the learning we mean that they are both the aims of the work and the attributes which have to be built up if progress is to be made. There are two lists, one for 'earlier' and one for 'later' development in the 5 to 13 age range. Some items are common to both lists and some are different. [34] Here are examples of some items on the list for 'earlier' development:

observing, exploring, applying learning . . .
concepts of time, weight, cause and effect. . .
curiosity, originality, openmindedness . . .

A further step to be taken in answering the question 'What should we look for?' was to become more specific about how these

attributes can be observed in children. Again using the help of groups of teachers we took each item on the lists and tried to identify the kinds of behaviour which would indicate various levels of development. [35] So, for example, for applying learning we arrived at a statement for level one, the base-line as it were:

Rarely makes use of previous learning in a new situation without help.

For level two, showing signs of development:

Makes an attempt at tackling new problems but may fail through applying skills or knowledge which are not relevant.

For the third level, the most mature expected at the early stage:

Generally makes use of previous learning which will help with a new problem.

The resulting check-lists comprise statements at three levels, in this kind of form, for each attribute, suggesting the kind of actions and responses of children to notice as a guide for finding out where a child has reached in development. In using the statements as a guide to observation *it is emphasized that information should come from observing a child in a variety of situations, over an extended time, not from an isolated instance of behaviour.*

The check-list statements suggest what to look for and also provide a *framework* for turning observations into knowledge about a child's development. This goes some way towards answering the second question [36] 'How can we interpret what is observed?' The ordering of the statements in the check-lists suggests the child's position in development of each attribute and, when observations of all of the items on the list are brought together, the result gives a profile of a child showing his relative strengths and weaknesses. The information will mostly be gathered and used immediately in making decisions, but there is an additional benefit to be found in occasionally making a systematic record. [37] For instance, this is the record of Simon made when he was six, in 1973. His profile, as indicated by the brown shaded areas, gives important information about where he needs special help, and is a basis for making decisions when the teacher is guiding him. A second record [38] made some months later on the same sheet (here is Simon's record in 1974) shows by yellow shading where progress has been made.

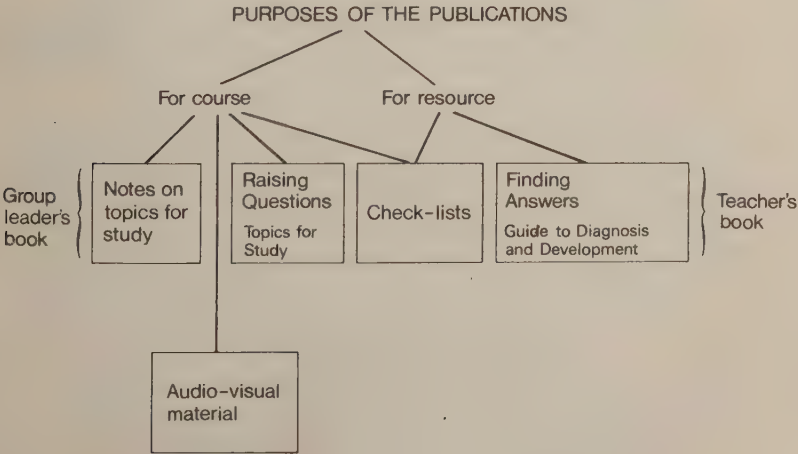
But there is more to the process of trying to match learning experiences to children than using a check-list. It involves an approach to teaching in which feedback about the children is constantly used, and each decision is followed up by gathering more information and using it for adjusting to the ever changing

situation. This is an approach which is not at all adequately conveyed through written materials alone, which is why the project is presenting its ideas and suggestions through in-service courses. [39] These main themes are covered by the in-service courses:

Making and recording observations about children,
which covers the development and use of the check-lists in detail,
Children's development and learning,
which discusses the relevance to his learning of factors within the child himself—his attitudes, feelings, past experience, and so on.

Making decisions about the learning environment,
which raises questions about how factors external to the child can influence his learning—the classroom organization, his activities and his interaction with the teacher.

Now we come to the third question [40], about which activities and approaches are appropriate. We have addressed this subject in the book entitled *Finding Answers*: 'A guide to Diagnosis and Development', which suggests what are likely to be the kinds of experience suitable for children at different stages of development. Teachers will occasionally refer to this book during in-service meetings, but it is chiefly a resource for use after the course. It suggests broad guide-lines for selecting and adapting activities and approaches in ways which suits varying requirements; it has sections on each of the attributes in the check-lists which attempt to explain, and to illustrate, development and to suggest how progress at each point might be helped.



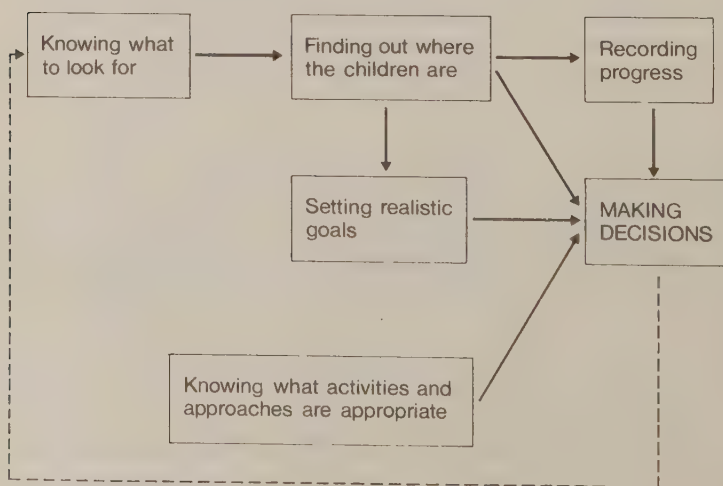
[41] We can summarize the publications as having two main purposes—for use during a course and as a resource.

Raising Questions consists of 20 topics for study during courses and also serves as a guide for self-instruction for those who are not able to join in a group with others. To help those who organize and lead courses there is a *Leader's Guide*; there is also the audio-visual material for use during meetings. After a course the main resource material is the book *Finding Answers* and the check-lists, though some sections of *Raising Questions* will probably also be used for reference.

Now that we have looked at what the publications are it is fair to ask the question: How would this help someone like Christopher's teacher? [42] We think it would help her in several ways:

- to build up knowledge of aspects of Christopher's progress and so to know what are likely to be the causes of his problems,
- to know where he is weak and needs extra help,
- to set goals for Christopher which are realistic and attainable and will give them both a sense of satisfaction,
- to appreciate the range of characteristics which are important, and to value activities and approaches which encourage positive attitudes rather than only those which lead to acquisition of knowledge.

[43] It will not provide her with directions for the 'right' response to Christopher in this particular situation because it is unique, but it will equip her with the information and the guide-lines she needs for making her decision.



So, in conclusion [44], we can put in more general terms the purpose of *Match and Mismatch* as attempting to help teachers make decisions and record progress. It does this by suggesting what to look for so that teachers can find out where each child is, and by indicating what are realistic goals and appropriate experiences at different points in learning. The whole process forms a cycle in which the effects of decisions are observed and provide feedback for use in making further decisions.

The introduction has had to touch on a great many points, dealing with each only briefly. The topics covered in this book take these points and others into much more detail, so there is no need to worry if you feel that there has been rather too much to take in at one time. However, we do hope that you have an overall picture of

- the purpose of the project,
- what it *is* trying to do,
- what it is *not* trying to do,
- the form and function of its products.

It may be worth while to discuss these points briefly with others if you can, so that there is a shared understanding of what the project is offering.

A second important matter which you may wish to consider at this point (though it will arise again in later discussions) is the interpretation of what is meant by 'learning science', expressed in the words in *italics* on page 2.

A third subject which arises from the Overview is 'matching'. This, too, will be a recurring theme but some discussion at this early stage may help to clarify the meaning attached to the word in this context. The following section can be read, or heard on tape, or both.

Why 'matching'? (*audio-tape*)

The notion of 'matching' is central to our ideas about helping children to make progress. It is a theme which runs through several discussions and appears in many parts of the materials where we examine in some detail various aspects of the process of matching. What we want to do here is give an overview of the chief reasons for considering that an essential part of an effective teaching strategy is an attempt to match experiences to children's development in the various skills, attitudes and concepts involved.

The reasons we propose fall into three groups:

- the first arise from what is known about the way children learn,
- the second come from evidence of 'mismatching',
- the third from the opinions of experienced teachers.

What do theories of children's learning tell us? We shall be making use of Piaget's description of mental development in the theme on 'Children's Development and Learning', but Piaget is not the only person to have stressed 'matching'. The importance of using methods and modes of communication which fit the point a child has reached is widely acknowledged by experts, who may differ on other matters, but not on this. A child can use only the ways of thinking and reasoning which he has built up himself to help him make sense of new experience. If the new experience is too far beyond the reach of his present ideas he not only fails to make sense of it but also misses a chance of advancing his ways of thinking. On the other hand when his activities *are* at a level at which he can make sense of them they enlarge his knowledge *and* help to strengthen, or perhaps modify, his abilities and ideas. It is through modifying existing ways of thinking to take account of new experience that mental development takes place: thus the notion of 'matching' also embraces that of 'extending'; it is not a static but a dynamic process.

The second set of reasons we suggest in favour of matching come from considering what happens in its absence. The mismatch can arise either when experiences require more advanced ideas than a child possesses or when they are at too simple a level and give no opportunity for extending mental abilities. In these circumstances children *do* learn something, but it is not what we intend them to learn; instead they may be learning that school is a boring place, or a place where they are bewildered and never able to do what is expected of them. Repeated experience of failure may set up a vicious circle in which both teacher and child reach the conclusion that the child is never going to succeed, and this in itself makes further failure more likely. Of course occasional failure, and unavoidable mismatching which must occur at certain times, will not be damaging; it is when repeated failure is the general pattern that a child will inevitably regard his work in a negative way and come to dislike school and all that is associated with it, and may even develop a negative attitude towards himself.

Thirdly, we find that experts in the field of education emphasize the importance of matching based on evidence from practical experience rather than from any theoretical standpoint. The Plowden Report sums up the point most clearly, reflecting the opinions of the many teachers the committee consulted:

There has to be the right mixture of the familiar and the novel, the right match to the stage of learning the child has reached. If the material is too familiar or the learning skills too easy the children will become inattentive and bored. If too great maturity is demanded of them, they fall back on

half-remembered formulae and become concerned only to give the reply the teacher wants. Children can think and form concepts so long as they work at their own level and are not made to feel that they are failures.*

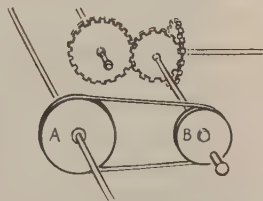
Now even though these may be good arguments in favour of matching they do not tell us much about what it means in practice and how we can go about it. Matching is not a simple concept; for as we have suggested it involves extension, and promotes change in children's thinking, so the situation is never quite the same from one point to the next. To make matters more difficult we have to admit that there is little precise knowledge about activities and treatments which are best suited to different ways of thinking. There are no easy answers, no formulae to follow, which is why we have to study the whole situation in detail and arrive at a strategy for making decisions which take account of the uniqueness of every child. The same strategy can be used for all the children whilst the learning experiences which its application suggests will in general be different for each child.

What is implied here is that we think of and cater for children as individuals as far as possible. But this doesn't mean that they learn in isolation—far from it, for group work, social interaction during learning, and regular involvement in whole class activities are essential for the development of certain important attitudes and personal qualities. What it does mean is that the level at which the activities are carried out by a child and the expectations set for him should take account of his unique set of strengths and weaknesses. We think that this individual catering should be possible at least throughout the period when children are learning how to learn, which includes and extends beyond the age range of 5 to 13 years covered by *Match and Mismatch*.

Catering for individuals within a group learning situation

Two pairs of ten and eleven-year-old children had been independently trying out various ways of fixing cogwheels together. They decided after a while to put their efforts together to make one big mass of movement and wheels.

When the wheels were driven from a handle at B, Jennifer said that wheel A was not necessary any more, but Stuart was quite sure that 'That wheel makes all the others go round.' Jennifer and her partner continued



* C.A.C.E. Report *Children and their Primary Schools*. Para. 533. London: H.M.S.O. 1967.

to work out how to make one wheel rotate in a plane at 90° to another, whilst Stuart investigated the effect of taking A away, and looked more carefully at how each cog was connected to the others. Meanwhile Peter, who seemed to think that the solution to both Stuart's and Jennifer's problems were 'obvious', was preparing to drive the assembly using a small electric motor.

Topic 2: Helping children learn by learning about children

The purpose in this topic is to provide examples of how knowing children can suggest how a teacher can help them, and to establish the variety of circumstances which may be responsible for 'mismatching'.

After the broad view of matching presented in somewhat theoretical terms in the last topic, we begin this one on a more practical note, with a profile of one child. It shows how his teacher used her knowledge of him in trying to match his experiences to different aspects of his development.

Matching activities to Simon's development (tape/filmstrip)

[1] The following account picks out just a few of the decisions made by Simon's teacher about his activities. In deciding the kind of experiences which would best help Simon his teacher was using her knowledge of him built up over the whole time she had known him, and also the new information which she was picking up all the time by watching and helping him. Before we consider the specific examples let's look at her background knowledge concerning seven-year-old Simon.

[2] Simon is the youngest in a family of three children. On entering school he had a lisp and for some time experienced problems in expressing himself orally which seemed to delay his readiness for reading. He lacks confidence and has always tended to work with, or to follow, other children, mainly boys a little older than himself on whom he is inclined to depend. [3] He is healthy, active and fond of sport, and his willingness to co-operate wins him many friends. Although his oral and written communication is not well developed, he shows pleasure and some degree of competence in expressing himself through handling materials such as clay, crayons, felt pens, and in dramatic play. [4] He often draws pictures jointly with other boys, the products usually being detailed and representative of some current event. He is fond of living creatures and sensitive to the natural environment. [5] He has his own little patch of school garden and cultivates it with care, often

spending his dinner hours working in it. He has frequently brought small creatures found in his garden into the classroom for close observation using a magnifying glass and has tried to identify them with the aid of pictures in reference books. [6] One day he found a bird's wing, and this was brought for identification. In tasks like this he can show great perseverance.

It was Simon's interest in the school pets which provided his teacher with information about his grasp of ideas about length and its measurement. Simon and some friends had been greatly concerned that the rabbit did not have a run. [7] During play time one day they came across some materials discarded by workmen at the school—some wire netting, a few bricks and some wood, and started to try to make a run with these and an old sand tray which they were given. The teacher provided some tools and kept a watchful eye on the proceedings for safety's sake. [8] Simon was finding the lengths of wood he needed by trial and error matching, causing himself many journeys between the pile and the rabbit hutch where they were working. The rest of the group were measuring the length of pieces they required before carrying them over. [9] The teacher had noticed the same kind of approach in Simon's brick building. Back in the classroom she made opportunities to encourage Simon to talk about the lengths of objects, to compare and match lengths in junk modelling and brick building. She tried helping him to use a ruler, but Simon seemed happier using a different object as a means of comparing lengths at first. [10] She made use of his interest in dressing up to encourage his ideas about length—which clothes would be the right length, which was longer, and so on.

At that time Simon's ideas about weight were also immature by comparison with his classmates. [11] Once Simon built a see-saw using some large construction apparatus and after playing freely with it for some time he was given several objects to balance against each other and to arrange in order of weight if he could. When he was comparing a large block of wood and a tin of conkers he predicted that the conkers would weigh more because 'there are more of them'. The teacher then made sure that he had some large, light objects to balance against small, heavy ones, and that he tried weighing an object made from a construction kit as a whole, and as a collection of separate pieces. There was plenty of discussion, too, about how heavy different objects felt, and games in which weights were compared by hand. Things seemed to change rapidly in Simon's understanding of weight. Only a few weeks later a tree was cut down outside the classroom and the children asked if they could bring in some logs. With several others Simon enjoyed touching, smelling and lifting the logs. [12] They were heavy and some children wanted to know how heavy; they

weighed one log and were asked if they expected the weight to stay the same always. It was Simon who offered the suggestion that, since the wood was very wet and it would probably dry indoors it would become lighter after some time. Without prompting at all he checked the weight of the log daily for a fortnight.

Some activities which revealed Simon's development in the concept of time arose from the children watching a TV programme in which a water clock was demonstrated. Afterwards a group of whom Simon was the youngest, set about making their own version [13], and after experimenting they checked their water clock against a seconds timer. The teacher noticed that Simon was involved in the work only as the willing fetcher and carrier of water and other equipment they needed. He made no attempt to compare the rate of water flow through holes of different size as the others did, and was even unable to say whether one arrangement was running faster or slower than another. Without making it too obvious the teacher introduced timing into some of Simon's activities—how long did his cakes take to cook? How long does it take to change his shoes? Was it quicker or slower than yesterday? Does packing up take more or less time than calling the register? For some of these he used timers which he made himself and he also became quite good at estimating time intervals.

[14] A little later there was a discussion about slow-moving things and an attempt to put them in order of speed. Simon's group decided to time the movement of a worm. On this occasion Simon took an active part in the timing and, although he was not able to cope with the problem of comparing the worm's rate of movement with his own movement, as did two of the group, he showed that he understood the passing of an interval of time and was able to measure it.

Some work on area was prompted by the delivery of new tables for the classroom. Was there the same room on the top of the new tables as on the old? How much surface space was there on two tables fitted together compared with separated ones? These kinds of problem were tackled successfully by Simon's two working companions who began to use squares as a unit of measurement, but Simon himself was still doubtful about conservation when the shape or position of an area was changed, or when it was divided up. He continued to work beside the other two but was operating at a different level. [15] The group pursued their work outside, using large square units to measure the area of a circle marked on the playground. Then they tied ropes together to a length equalling the circumference of the circle and altered the shape to a triangle. Was the area of the triangle the same as that of the circle? The two boys gave different answers; Simon agreed with both! Apparently he was not following the point in question, nor thinking independently. On many occasions he chose to agree with his

friends rather than think things out for himself, and he didn't really see anything peculiar about agreeing with both conflicting opinions. [16] Without separating him from his companions his teacher made sure that Simon was encouraged to think about surface space, in covering boxes with paper, printing patterns, painting, tessellating various shapes, seeing how many different shapes he could make with tiles of a constant area, and so on. At the same time she provided situations where Simon had to work alone and make his own decisions. She often asked him to speak first when groups were reporting to others, and she made sure that he had experience of being the leader of a group on occasions. At the same time she was careful to do this in a way which did not make him feel insecure or lessen his willing co-operation.

The examples given in this sequence illustrate a few of the situations in which Simon's teacher took decisions about his activities. Many more could have been given since this teacher's way of working involved a constant response to information she gathered through observing her pupils closely. (It was Simon's profile which was given on the slide in the 'Overview' sequence, and it is reproduced in part for later study on page 55.) It has not been possible to describe all the instances of behaviour which gave the teacher clues to Simon's development so the few examples cited should be taken as representative of many more similar observations; his lack of independence for instance, showed in very many situations other than the discussion about area.

Questions which might be discussed about this case include:

What part did information about Simon known to the teacher play in the decisions she took about experiences to provide for him?

To what extent were her decisions related to a ready-made plan of activities?

How did she decide what expectations to have of Simon?

Looking at things from Simon's point of view, was he meeting challenges successfully or would he be likely to feel that he was failing compared with his friends?

Did Simon's teacher always choose what was really best for him?—are there dangers in teachers making *ad hoc* decisions like this?

'Some matches, some mismatches' (*video-tape recording*)

The video-tape shows sequences taken from recordings made whilst children were working on practical problems.* These extracts were

* If you are interested in how and where the video-recordings were made please see Supplementary Material, pages 198 to 200.

selected because they show particular actions and responses indicating that in some cases the activities and children were 'matched' and in other cases 'mismatched'.

Whilst watching or reading the transcript look for signs which suggest to you a match or a mismatch. What is it about anything the children say or do, or in the way they behave, which is the evidence for your judgment? What factors do you think might have influenced the matching? Keep these things in mind, and after watching and discussing the sequences make notes on a table as suggested on page 24.

Commentary

Daily work in the classroom constantly faces teachers with decisions about what activities to suggest to children, about the provision of materials and equipment, how to help children with particular problems, how to stimulate those who seem uninterested or lacking in ideas of their own.

In making such decisions it is important to try to suggest experiences which match as far as is possible the children's abilities and development, and thus give them the best chance of learning. But there are so many facts to be considered that it is almost impossible for there to be complete matching.

However we may be better prepared for avoiding the worst errors of mismatching if we can recognize the symptoms and link them to the several possible factors which might be the cause in any particular case.

Sometimes the symptoms of mismatching are not difficult to see, as in the case of Colin and Stephen, who are supposed to be sorting—first pieces of fabric and later a collection of buttons.

Colin and Stephen are supposed to be sorting pieces of fabric into piles. Stephen is resting his head on his hand whilst Colin is putting all the pieces into one pile.

STEPHEN (*calling to teacher*) Colin's sorting them out nicely. (*Begins to pass a few pieces to Colin*) Here you are. 'Ere you are. Miss, we've done it!

Whilst waiting for the teacher they turn their attention to the bowl of buttons.

COLIN (*quietly*) In a minute we'll be told to sort out these.

They are now sorting the buttons, with little enthusiasm, into piles of similar colours.

COLIN We don't like to do these, do we? We don't like doing this—sorting out.

Stephen looks up at the cameras.

STEPHEN Oh, they've got wheels, them machines.

COLIN Yea.

STEPHEN Number one, number two. (*reading the numbers on the two cameras*).

COLIN Number one, number two.

STEPHEN Number three.

COLIN Number four.

STEPHEN Number five.

COLIN Number six.

STEPHEN Number seven.

COLIN Number eight.

STEPHEN Number nine.

COLIN Number ten.

STEPHEN Eleven.

TEACHER Now, then . . .

STEPHEN Miss, we've sorted them out.

Stephen indicates the buttons still in the dish, not the ones which have been sorted on the table.

TEACHER You've sorted those out—why have you put them together in the dish then?

STEPHEN Cos . . . cos . . . cos . . . that makes them nice.

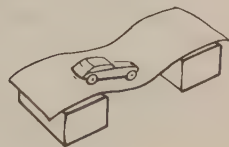
TEACHER 'Cos that makes them nice. You put them in there because it makes them nice.

Commentary

There are some obvious signs of mismatching here—the scant attention they give to the objects doesn't indicate much interest or involvement in the work, and they are easily distracted by the other things going on around them.

The signs are not always so striking, of course. We now see two pairs of children working on the same problem, that of building a bridge from paper across two bricks which has to be strong enough to hold the toy cars. First we see Duncan and Michelle.

Duncan and Michelle have placed a piece of paper across the gap between the two bricks and are trying to make cars go across it—they get stuck where the paper sags between the bricks.



DUNCAN I'm going to try again. If you do it fast it might go over. (*he is holding the paper with one hand.*)

MICHELLE Not all cars go fast.

DUNCAN Mmm... See! (*Makes engine noise as he pushes a car across, ignoring Michelle.*)

MICHELLE Not all cars go fast.

DUNCAN (*Laughing as the paper falls off*) You've got my car. Oh no...

MICHELLE —other one.

DUNCAN No, that's (?) car, that's mine. You can have all the rest.

MICHELLE Let's put all the bits on.

She places several sheets of paper over the one already across the bridge.

DUNCAN (*Making noise of car engine*) That's the best car, that's a good one, back opens.

MICHELLE Now let's see it... think...

DUNCAN Ah, that opens, huh! (*playing with car*)

MICHELLE All right then, you do it—that's half way, right?

DUNCAN Yea, and you do it that way, and we'll have a crash up.

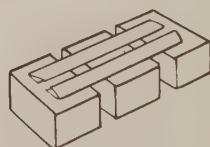
MICHELLE (*While Duncan is talking*) that goes that way, and that goes that way...

DUNCAN (*Whilst Michelle is still talking*) I'll push it.

MICHELLE ... but we go that way instead.

DUNCAN Now you put yours over that way, 'cos I'm going to have a crash up.

They have now folded the pieces of paper making the bridge, and a third brick has been put in between the other two.



MICHELLE We need a longer bridge.

DUNCAN See?

MICHELLE We need a longer bridge.

DUNCAN Yea, need a longer bridge.

Duncan turns two of the bricks through 90° and Michelle helps.

DUNCAN —now, that—

MICHELLE We need that double, don't we?

DUNCAN It don't matter. If we have it like that, it'll be a long bridge and we can just put these across.

All three bricks are now in a line, and Duncan is putting the folded paper strips along the top.



DUNCAN Oh, no. I see what you mean—look!

The paper falls off the top of the bricks and he then runs a car along, which comes off the side half-way along.

DUNCAN If we put fencing up there (*holding his hands to make barriers at the edges of the bricks...*)

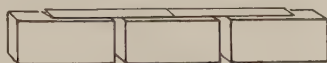
Duncan takes car across bricks making engine noise.

DUNCAN Boing!

MICHELLE Let's put these on like this—

Michelle replaces the paper on the top, this time tucking the end of one into the next.

DUNCAN Yea, I know, it's interlocking again.



DUNCAN Oh yea—clever clogs! I should have thought of that!

MICHELLE Ah, very funny.

DUNCAN (*to teacher*) We've found something, Miss. (*as teacher arrives*) Well, if we put that like that (*mumbling*)...

MICHELLE No, it wouldn't—

TEACHER (*Faint*) But you haven't got a bridge, have you? Where's the bridge?

Pause.

What does a bridge do?

DUNCAN Oh, I see

They begin to turn the bricks round again to form a bridge.

Commentary

In spite of this reminder from the teacher of the problem which they were supposed to be trying to tackle they again stray away into activity which is unrelated to it.

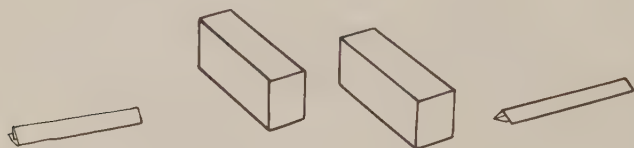
They now have two bricks on end and one on its side and are making a very steep 'bridge' using a folded strip of paper.



- MICHELLE Look if we put—like that, and lean to like that, and move them up—
- DUNCAN Yea, a minute. Try a light car, that one's the li... no this one's...
- MICHELLE Yes, that's right
- DUNCAN Yes, it just about does it. Miss, we've discovered something (*turning in direction of teacher*). If...

Commentary

It is helpful in highlighting symptoms of mismatching if we contrast the children we have just seen with Yolanda and Malbinder who were presented with the same problem.

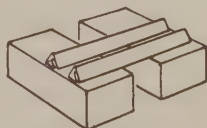


- YOLANDA I know what we can do, make lots of er... of er... sort of... bars. Roll them all up, like, so that you lay them across, then put one piece on top of it.
- MALBINDER Yea.
- YOLANDA Yes, I know the best way to make it stronger will be to... triangles.

They are both folding the paper over and over into flat rolls.

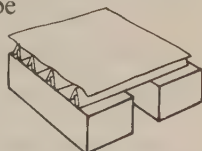
- MALBINDER Keeping making it go like this.
- YOLANDA Well what you do to make it stronger is like that.
- MALBINDER We're only allowed to use this much paper.
- YOLANDA Only this much?
- MALBINDER Yes I think so.
- YOLANDA Cross it over like that (*running her fingers down the creases*). Look, if you go like that sort of thing, so that you've got a triangle. Just make loads of them like that.

She places the pieces across the bricks, opening the folds so that they stand up as triangular bars.



- YOLANDA If we do it all like that now. Make it very firm.
- MALBINDER I've got an idea...

- YOLANDA If we go like that, right, and after we've gone like that then one bit put across like that should be able to do it... put one in the centre.
- MALBINDER If we put these two... and these two either side like that.
- YOLANDA Now how we're going to make it sort of stay? (*Puzzling about how to keep the triangular section pieces open.*) No, I think it would be better—Yea, like that.
- MALBINDER (*Picks up cars and feels the weight of them in his hand.*) Cars are quite light, except for this one.
- YOLANDA I know, we'll put the paper across and test it, right?
- MALBINDER Right.
- YOLANDA Not very safe.



Commentary

These two immediately grasped the problem, seemed to become interested in it and their activity was related to solving it, not just using the materials in any way which occurred to them, as happened with Duncan and Michelle. Evidently they had previous experience of structures which they saw was relevant and were able to apply.

Now we shall see two more pairs of children working on a different problem which concerns three eggs which look alike but differ in that one is hard-boiled, one soft-boiled and one raw. We first see David and June trying to identify which is which—without breaking the eggs.

June and David have already put all three eggs in tap water and in salt water to see whether they sink or float. They have brought a wooden suspended pan balance to the table as well as the two jars of liquid which they were given. David has a pencil in his hand and is writing down their observations so far.

- DAVID What about... what does B do? Sink?
- JUNE Sink, you put that...
- DAVID Yes, which way does it go up?
- JUNE Like that way, like that way— (*She holds one egg* ○)
- DAVID Side?
- JUNE Like that.
- DAVID On its side... on its side.

June starts balancing one egg against another in the scale pans.

- DAVID Then C is? (*Pause*) So we know there's some difference.

- JUNE That's the hard-boiled one (*pointing to the egg in the pan which goes down*).
- DAVID What does C do?
- JUNE Sink.
- DAVID That went the right way, didn't it?
Did C go the right way?
Oy, did C go like this?
Oy... oy... oy... oy

He tries to attract June's attention but she is busy balancing.

- JUNE Feel that, one's heavier than the other.

She hands the two eggs to David who feels the weight in his hands.

- JUNE Yea, it's heavier—but it's not on the scales, watch. Mind out.

They put them on the scales.

- DAVID Yes it is!
- JUNE Yes it is, yes.
- DAVID That one's heavier.
- JUNE A's heavier.



David goes to put this down on his paper.

- JUNE Now where's C. These feel the same. (*She puts A and C on the scales.*)
- DAVID C and A, is it?
- JUNE Yea.
- DAVID C and A...
- JUNE A is heavier. A's the hard-boiled. C's medium boiled and B is... not boiled.
- DAVID How do you know?

The teacher is now with them and David is just taking an egg from the salt water

- DAVID I think—sound, might do it.
- TEACHER You think?
- DAVID Sound.
- TEACHER Sound?
- DAVID Yea.
- TEACHER How?
- JUNE I'll get B out. Oh go on, then...
- DAVID The lower sound, the lower sound...
- JUNE —mind out!
- DAVID ... is the hardest, and so on, I think—not sure if it'll work.

June begins to tap an egg gently on the table listening to the sound. David does the same.

DAVID Hard-boiled (*laughing*).

JUNE Hard-boiled . . . hard-boiled or that would have cracked by now!

TEACHER What else could you do with them without cracking them?

JUNE Roll them.

TEACHER All right. Well try rolling them.

Teacher leaves them and June is the first again to try rolling an egg by giving it a push across the table.

JUNE They curve . . .

DAVID They won't go straight.

JUNE Again, do it again.

DAVID (*Mutters*)

JUNE That was me.

DAVID (*Mutters*)

JUNE Well dip it in water, it should leave a trail, shouldn't it?

DAVID And when it sinks, watch it . . . Turns right round.

JUNE Turns.

June just holds her egg beneath the surface.

DAVID Just let it go and it will . . . just see if it comes right round.

JUNE Mind out the way (*she rolls the wet egg across the table*).
Just curves a little . . .

David returns to dropping the eggs in the salt water.

DAVID This one sinks right down to the bottom . . .

JUNE then comes up . . .

DAVID comes up, yea but that . . .

JUNE That one's the medium, that one's the hard and this one's . . .

DAVID Raw.

JUNE not been . . .

DAVID . . . raw

JUNE . . . done. Well no, watch.

DAVID That one sinks.

JUNE That's only when you plop it in. Don't plop it. You plopped it.

DAVID I know what . . .

DAVID . . . it don't make no difference really do it?

TEACHER It doesn't at all? Have you tried spinning it at all?

JUNE No.

DAVID We have in the water.

They start spinning the eggs. David finds one won't spin.

TEACHER What about the other one?

DAVID Oh!

TEACHER What happens to that one?

DAVID You can't, you can't spin it!

TEACHER Well perhaps that's something different.

DAVID Try it. See!

June tries spinning the one which David couldn't spin.

JUNE I think you can a bit.

DAVID That one . . . spins so bad.

JUNE Ooh!

DAVID It spins even faster.

JUNE Mind out the way. See if I can spin it.

DAVID See, can't. Hard-boiled.

JUNE This is the hard-boiled one, the one I said, isn't it?

Commentary

June and David did not lack ideas of things to do and they are certainly active all the time. Several things which they tried could have led them on to draw conclusions about the eggs but there was no logical framework linking their statements to their observations. Tentatively we might infer from this that they were unable to employ the kind of thinking which enables them to relate their findings to the possible properties of the insides of the eggs. Contrast this behaviour with that of Deidre and Allyson, working on the same problem, but with different eggs.

Deidre is taking an egg from the jar of salt water.

ALLYSON Put them both . . .

DEIDRE A, no A in there. *(She puts the egg in the tap water and it hits the bottom rather hard.)*

ALLYSON Oh, Deidre! For all we know that could be the raw one and it would smash.

Deidre, unperturbed, continues to concentrate, now placing egg B in the salt water.

DEIDRE This rises.

ALLYSON B.

DEIDRE B is what?

ALLYSON You know that's funny, C rose just now, so therefore that one might be hard-boiled.

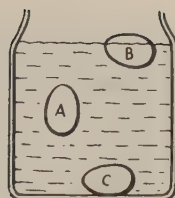
ALLYSON Eh? That's playing tricks on us, put another one there.

Deidre puts B in the salt water again.

DEIDRE Bet that one will rise again.

ALLYSON So B is wrong.

Deidre takes A from the tap water and places it in the salt.



DEIDRE How come they stay floating in salty water though... um?

ALLYSON Don't know. All right two of them floated so I think that's—C is the raw one, we made a conclusion, didn't we?

DEIDRE Why do you think it's the raw one?

ALLYSON 'Cos bad eggs float to the top.

DEIDRE Yea but they're not bad are they?

ALLYSON I know, but there must be something done to them...

DEIDRE One of them's medium.

ALLYSON Yes. They're medium and hard I think... and that's raw.

DEIDRE But I thought they might... the hard-boiled one might be heavier. It might fall down to the bottom and that might be hard-boiled.

ALLYSON Can I have a go with that one now, in the water.

She takes an egg to the tap water, collects another and prepares to let them fall together.

ALLYSON Can I have the other one? I'm going to let them go level and see which goes down and goes down to the bottom first.

DEIDRE You got to keep them together. (*She lets two eggs fall in the water.*)

ALLYSON They both went... I think that...

DEIDRE I've got a feeling this one's hard-boiled.

ALLYSON I've got a feeling that... these are your feelings, right? You think that C is hard-boiled; I think it's raw. I think that B is medium, no, hard-boiled...

DEIDRE I think that B is raw.

ALLYSON ... and, we both think that this one is medium. Let's try and work out why it's medium. 'Cos there must be some reason.

DEIDRE I don't think there's any differences in the weight.

ALLYSON There's not, there can't be. (*Pause*) It's just the way they're cooked.

They are now rolling eggs from side to side across the table.

DEIDRE ... let's take them back again. Right C we think is...

ALLYSON raw.

DEIDRE raw, that's supposed to be raw, right?

ALLYSON Yea.

DEIDRE Mind your hand.

The egg she rolls goes in a fairly straight line.

DEIDRE Well that goes straight up, right?

ALLYSON Yea, because, with um, with the hard-boiled one, the stuff will stay kind of solid won't it, and it won't move about. But with this it will move the way the egg was rolling, wouldn't it?

DEIDRE What the yolk?

ALLYSON Yea, and it'll balance it up.

DEIDRE So that's, you think that's raw. That's something, you think... I think B.

Commentary

These girls tried to argue logically, using their observations as evidence for or against the various possibilities for each egg. A significant step in Allyson's thinking was linking the runniness of the inside of the egg to its behaviour in rolling. This is in contrast to David and June who claimed almost any piece of evidence as

<i>Sequence</i>	<i>Indications of match or mismatch</i>	<i>Possible influential factors</i>
Colin and Stephen sorting		
Duncan and Michelle building bridge with paper		
Yolanda and Malbinder building bridge with paper		
David and June investigating eggs		
Deidre and Allyson investigating eggs		

confirmation for their own ideas without considering alternative interpretations. It seems likely that Deidre and Allyson can hold the range of conditions for each egg in their heads and gradually build up evidence in favour of one conclusion or another; thus the activity is better matched to their level of thinking than in the case of David and June.

You might like to draw up a table like the one on p. 24, then, using the transcript if necessary as an aid in recalling the sequences, fill it in. Afterwards compare and discuss your ideas with others in the group.

Summary of themes and topics in this book

Theme A: Making and Recording Observations about Children	Theme B: Children's Development and Learning	Theme C: Making Decisions about the Learning Environment
Concerned with the kinds of information about children which are required as a basis for matching. Involves considering what are the goals of learning science, and various ways in which progress towards the goals can be observed and recorded. Introduces the check-lists and gives practice in using them.	Provides descriptions and examples of children's development in certain attitudes and intellectual skills. Discusses Piaget's description of factors influencing development and implications for matching. Considers matching in theory and various ways of putting it into practice.	Draws attention to the wide range of choice a teacher has in many features of children's learning environment. Discusses the effects of different organizations on goals the pupils can achieve. Considers how activities can be chosen or adapted to suit variations in development between children. Introduces <i>Finding Answers</i> .
<i>Titles of topics:</i> 1 Finding out about children. 2 What information is of most use? 3 Recognizing the presence of various characteristics. 4 Introduction to the check-list statements. 5 Familiarization with the check-lists. 6 The value of making and recording observations.	<i>Titles of topics:</i> 1 Exploring children's thinking and feelings. 2 Attitudes and how they develop. 3 Different ways of thinking. 4 Development in thinking. 5 Matching in theory. 6 Matching in practice.	<i>Titles of topics:</i> 1 What can be varied? 2 Classroom organizations and constraints. 3 Making decisions about activities. 4 Adapting to levels of thinking. 5 The teacher's role in supporting progress. 6 The teacher's role in developing positive attitudes and personal characteristics.

The many different kinds of factor which have some influence on the extent to which there is matching or mismatching are considered in the rest of this book as part of three main themes. The themes can be studied in any order and the above summary of the topics within each is provided as an aid in deciding which might be your best starting point.

Theme A: Making and Recording Observations about Children

Topic 1 Finding out about children

The purpose of this topic is to discuss various ways of finding out about children's abilities and characteristics, and to consider what is the most relevant method for gathering information which can be used to help in matching.

In the introductory topics some arguments were outlined in favour of matching and knowing about our children's development.

It is all very well to talk about the importance of gathering and using feedback about children's ideas but we are not much further forward unless we have a straightforward and practical way of doing it.

All teachers have some if not all new children at the beginning of the school year and the problems of getting to know them are then greatest. Here are some examples of how teachers find out about children who are new to them. Which do you think are inadequate, and for what reasons? Which is nearest to your own method? Which do you think is the best approach, even if it is not your own, and why?

'Before I start any group or individual work I give them a poem to write out, a test of tables and a spelling test. This gives me a fair idea of which ones to group together for various activities and I change the groups later as I get to know them.'

(Teacher of 8 and 9 year olds)

'I find out from records or their last teacher what they were doing previously and get them started on something similar while I go round and talk to them. Then I can help them with what they're doing at the same time as noticing how they tackle different things.'

(Teacher of 6 and 7 year olds)

'It's best to start with a project, something new and exciting, let them choose their working groups and tell each group what to do. Then you've got a chance to see how they work together and what they can do.'

(Teacher of 9 year olds)

'At the start you don't know which are the bright or the dull ones so you have to find out. I start with some work which I think should be at the right level and they all have to try to do it. Very soon I can see who is getting ahead and who is falling behind and then I find their different levels.'

(Teacher of 10 and 11 year olds)

'I prepare a variety of materials and then discuss with them all together things they could do, and let them choose. If they're not used to this it takes

time to organize but it all helps me to get to know them and them to find out about my ways. I discuss with each group the work they chose and what they might go on to from there. This is just the start of things, and I'm still discovering more about them when the first term is nearly over.'

(Teacher of 7 year olds)

'I give them a maths test on the first morning and put them into ability groups.'

(Teacher of 10 year olds)

Are tests the answer?

For some teachers tests provide a quick and ready method for finding out about children's achievement. Tests have certain features which make them useful for particular purposes but they also have several limitations which make them unsuitable for the purposes of getting to know children and gathering feedback required for matching. Perhaps the greatest of these limitations is that written tests can cover only a narrow range of knowledge and skills, whilst making decisions about activities and approaches requires a teacher to have information about a wide range of characteristics and abilities of each child.

If you are interested in pursuing this matter further you will find additional points about the pros and cons of testing in the Supplementary Material (see pages 188 to 190).

What can we do instead of testing?

A method of gathering information which is more suited to our present purpose is to use the observations which teachers are all the time making of children's actions, responses and behaviours of different kinds.

Children are showing their attitudes and abilities all the time in their normal work; they are telling us all we need to know about their characteristics if only we can receive and interpret the messages.

We shall return later (Topic 5) to what is meant in this context by 'observation', but it should straight away be said that it is no more than many teachers already do, i.e.

- *looking* at the way pupils go about their work and not just at the products,
- *listening* to pupils' ideas and trying to understand their reasoning,
- *discussing* problems so that pupils reveal their ways of thinking.

Such observation provides a ready-made method for gathering information which has the advantage that

- it is flexible and can be used at any time,

- it does not interfere with normal activities or take up time,
- it can provide information about behaviours of all kinds,
- it can be used repeatedly, giving constant feedback,
- children are unaware of the process,
- it does not require special equipment or materials.

Benny (*tape/filmstrip*)

[1] Benny transferred to his present school when he was almost eight, just about two and a half years ago. He was not then in the class of the teacher who prepared this study of him. She remembers first being aware of Benny when he came to school with his large white rabbit [2]. He had apparently been unsettled in school and quite a worry to his teacher until that time, resisting most efforts to help him read and write. But when he was allowed to bring his pet he began to settle and to do some drawing and attempt some writing willingly. He shows keen interest in all animals and living in the country gives him plenty of opportunity to find out about many at first hand.

Now he is ten and several aspects of his behaviour indicate that he is becoming a responsible person and has a more positive attitude towards school. He sticks at his work and does the best he can without constant watching; he's always occupied and seems to find satisfaction in most of his activities. But it's only about a year since he really became able to read at all fluently [3] and began to use books for extending his knowledge of things he has been investigating directly. Now he often uses reference books, but rarely, if ever, reads fiction. [4]

Writing things down takes a lot of time and effort; he seems to enjoy most maths work but this is one of the tidier pages of his book. The stories he writes have been about 'Little Pete', a character in one of his reading books. [5] Far from being very creative, and very difficult to read.

Recently Benny was in a group working on area. He had the problem of selecting a suitable unit for measuring the area enclosed by a curved boundary. He chose drawing pins because of their curved edges [6]. But once he had found that a square was the most convenient unit he applied the idea a little later to the measurement of volume, choosing a cube as the unit for measurement [7]. Soon there came the problem of measuring irregular solids and the suggestion of using a displacement bucket came from Benny. In order to relate the volume of water displaced to the volume of the object immersed they were asked first to use a 1000 cubic centimetre block [8]. Before this was immersed the guesses of the children in the group as to the volume of water which would be displaced

ranged from 100 to 600 millilitres. When it was found to 1000 ml, Benny worked out the reason for himself. He said 'Oh I see, it's the things inside which must have room and so really that's what's being measured.' A few days later he applied the idea neatly in measuring the volume of a bottle which was taller than the bucket being used. [9] He stood the bottle in the bucket, marked the water level on the bottle and when the water had been displaced he refilled the bucket and immersed the other end up to the mark.

Benny enjoys making models. [10] He made this battery operated boat from wood, working on it over several months during which he shaped and reshaped the propeller blades until he was satisfied. He also experimented with the connections to the battery, making the propeller rotate in different directions and noting the effect on the motion of the boat. [11] He has an accurate and quite extensive knowledge of petrol engines, originating partly from his model aeroplane and partly from his experience of the machinery at a nearby farm. Here [12] he is explaining the working of a motor cycle to a younger child, John, who came to him for help. He gets on well with all age groups and often acts as a peace-maker in disputes. He kept John's attention for some time and produced this drawing to help [13].

'... there are two little pieces of metal—like that, very close to each other, about a millimetre away, and as this goes round it causes a spark and this spark jumps from side to side, side to side very quickly as the thing goes round, and that is exactly what happens in a spark plug. O.K.? A spark plug's like that, a little bit like that, and at the bottom here there's a little thing which does exactly the same, and the spark goes... and jumps from side to side.'

'I thought it would have gone out.'

'What, the spark? Well, it's like a little sort of short circuit, you see, and as that short circuit sparks it ignites the vapour, 'cos the piston is just timed to go up and down and to turn the magneto just in time to make the spark just at the right time. And, as it turns it causes a spark and the piston goes up and down and the vapour is ignited, you know, and that explodes and it pushes the piston down and turns the thing round the cogs, and turns the thing—right? And, when the fuel, I mean the carbon monoxide which is the exhaust, is pumped out of the exhaust, the exhaust pipe, um, the carbon monoxide is a bit like, er, you know if you burn petrol it causes carbon donoxide, carbon monoxide. If you burn petrol under pressure that causes carbon monoxide, that's exactly what is happening in there, burning under pressure, see?'

'What's this thing here?'

'That is the cylinder which encases this, you see, and that's inside, and the—this is a bad drawing actually, but there's, er, the piston up there, right, and the cylinder, the, er, what is it, the little piston

is going up and down inside there and is turning a wheel inside there, because there's a rod going down into the wheel and turning it round. At home I've got a motor, if I bring it tomorrow I'll show you what it's like . . . O.K.? 'cos you can screw the spark plug off—and we'll see if we can get it going. It's very messy . . .'

Next day he kept his promise to bring his aeroplane engine to show to John and spent all his spare time trying to make it work for him [14].

Benny shows his interest in the farm near his home by rising early to help with the milking on about two days a week. He describes his early morning walk to the farm [15] 'There's something nice about the dark and the night—one summer night I went over there and thousands, it seemed like thousands of bats were flying over my head and they're like great big moths and they're lovely, you know.'

'Yes,'

'And also you see a lot of owls and hear a lot of owls, and I can make the noise of an owl.'

'Can you, I'd like to hear that.'

'Towhit, towoo. The man who milks the cows, he found a baby owl and he took it home and nursed it but it escaped last . . . er, what's the year before November?'

'The month before November? October.'

'October it escaped in October.'

'How do you think you can find out what the owl's meal has been?'

'Well if you go under a tree you'll find owl pellets, old bones of mice and birds. My brother got some, and they eat other birds, and owls and rabbits and field mice and things.'

[16] Shortly before Christmas Benny was found in a quiet room with a small group of friends. They were practising a carol which they had composed themselves. (Part of their carol is heard on the tape followed by a conversation.)

'That's lovely, did you make that up?'

'Well Benedict made the words and Benedict put the music to it and we've all learnt it since.'

'Where did you get the music from Benny?'

'Just made it up.'

'We made the tune up and then we . . . got the chords which fit the tune.'

The picture of Benny drawn in this account is surely of a sensitive child with a wide range of interests, who is not slow to reason things out and apply his knowledge. But what picture of Benny would we get if we gave him a spelling test, a maths test, or looked only at his written work?

Make a child-study

There is an immense amount of information available about each child—more than we can recall or use at the appropriate time. It is necessary to be selective, and to decide the core of essential information which should be gathered. A useful approach is through making a study of a child in which you give the information about him/her which you think his/her teacher should have.

At this point we do not want to suggest the kind of thing to include in the study. Just choose a child well known to you (perhaps because he/she presents a problem) and record what you think is relevant to someone trying to help him/her at school.

N.B. Your study will be needed for the next session!

Topic 2: What information is of most use?

The purpose in this topic is to recognize the wide variety of information which may be needed to help children, and to discuss what it is most important to know about.

While you listen to the child-studies prepared by others in the group it will be useful for later discussion if you make a note of certain points. Should there be no other child-studies besides your own you may find the ones on pages 190 to 192 useful for comparison. Here are some things to note as you listen to (or read) the child-studies.

- 1 What subjects or kinds of activity are mentioned?
- 2 What personal qualities and personality factors are described?
- 3 What factors relating to home background are included?
- 4 Is there anything about the child's interests inside and outside school?
- 5 Are the statements made about the child mainly judgmental or mainly descriptive?

When all the child-studies have been considered, notice which factors are mentioned in almost all of them, and which are mentioned in only a few.

Are there certain kinds of information missing from some studies which you feel should be included?

Are some things not relevant in your opinion?

Is there any point in mentioning factors which are beyond the influence of teacher and school?

What reasons did you and others have for including some kinds of information but leaving others out?

Consider the *kind* of information which is offered as well as the

content. When examining your own and others' child-studies it is important to distinguish between inferences (that are deduced from evidence) and the evidence itself, e.g. 'He likes animals' is an inference; 'He often writes/talks/reads about animals' is evidence which might support this inference.

In order to interpret observations we have to draw inferences; it is unavoidable, but we should always be ready to question

- whether the evidence really supports the inference,
- whether the evidence is based on observations made on just one or on several occasions,
- whether more evidence is being sought and used to modify the inference.

What range of information is needed to help children learn 'science'?

Remember that the term science covers a broad area of activity in the primary and middle school years. To quote the Overview of the project (page 2).

'It is a way of learning involving first-hand experience, enquiry, problem solving, the interpretation and communication of findings and the development of attitudes which promote this way of working. In other words it refers to the kind of activity carried out in many areas of the curriculum as well as that called "science"'

Does this agree with your idea of what is meant by 'learning science' in the years 5 to 13?

After you have discussed your views you may like to look at criteria suggested for recognizing science activity in 'Is science being learned here' in the Supplementary Material (page 197).

Without going into detail at this point, what *kinds* of information about a child do we need to help him learn science? Perhaps you could write your ideas down and then compare them with what others think.

Going into detail

During the project several working parties of teachers discussed what they felt were important goals of learning science for pupils between 5 and 13. These goals were abilities, concepts and attitudes it was hoped children would develop through science activities. A teacher needs information about where the children are in the development of these attributes in order to make matching activities available; therefore they form the basis of a list of information required about the children.

Putting together the results of separate discussions by several groups of teachers produced the consensus of their opinions. It took the form

of two lists, one for 'earlier' and one for 'later' development in the age range considered. The items in the lists are given on pages 181 to 186 together with a brief statement to clarify the meaning of each.

However *before* you look at the project's lists, decide which of two possible courses of action you wish to take at this point: A or B.

A Those who took part in thinking out the goals found it helpful in stimulating critical thought about their work, and you may wish to do the same without being biased by what others worked out. If so, don't look at pages 181 to 186 until you have agreed some answers to these questions:

- what abilities relating to 'learning how to learn' can be strengthened through science activities (as defined on page 33)?
- what concepts, enabling children to make sense of the world around them, does learning science help to develop?
- what attitudes—to people, to things and to oneself—can be fostered through learning science?
- what personal qualities might be encouraged by science activities?

Try to answer each question by proposing no more than eight items. Is the meaning of each item clear and agreed by everyone in the group? It may be necessary to write a few words or short sentences to define each item. Look at the list as a whole; cut out repetitions and reduce overlap by combining any two goals which are close in meaning into one which covers both.

Then compare your list with the ones on pages 181 to 186.

B Turn to the lists of more detailed characteristics on pages 181 to 186. How do the items agree with what you consider to be characteristics relevant to learning science? You may like to take one list and comment on the meaning and importance of each item as a basis for discussion at the next meeting.

Topic 3: Recognizing the presence of various characteristics

The purpose in this topic is to say what certain abilities and skills mean in terms of how children behave when these abilities and skills are developing.

Exchanging comments with others about the lists of abilities and attributes relevant to learning science (pages 181 to 186) may suggest items which should be added and others which might be changed. Comparing the list you have been considering with the items of information which you included about the child in your child-study may also bring to light relevant aspects which are not covered. Additional items can be added, and changes noted.

The comparison of the child-study information with the listed items may also suggest aspects of the child which you would like now to include. For some characteristics this may not be as easy as it first seems, since it is necessary to know what to look for.

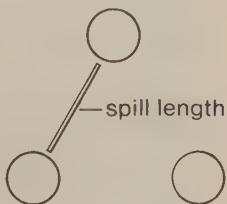
How does a child's ability to observe, for example, show? What do you look for when describing 'openmindedness', or a child's concept of causality (cause and effect)?

Perhaps it will help in defining ways in which various characteristics show in behaviour if we begin by examining our own actions and responses in circumstances where the characteristics should show. Look for various behaviours which imply 'problem solving' and 'curiosity' whilst you attempt the following activity and discuss reactions to something new.

Problem solving

Take four cups, tumblers, tins or anything which will act as stable supports, and a small bundle of wooden spills. Place three supports (use the cups or tumblers upside down) in a triangle so that they are all just too far apart for the spills to bridge across any two. Now try to build a platform, supported only by the three objects, which is strong enough to hold the fourth object in the middle.

If you succeed using more than three spills, try again using only three.



Curiosity

There was an object on the table throughout the meeting which had not been there before. Did you notice it? Did you ask someone about it? Did you touch it or want to touch it? Discuss your reactions and compare them with others and also with how you think a child might have reacted. Would a curious child react differently from a child who displayed little curiosity? If so, in what ways?

How do these characteristics show?

Now try to draw up a list of about ten or so behaviours relating to problem solving and/or to curiosity at whatever level, from simple to sophisticated. From this you may be able to define a series of 'things to look for' in children's behaviour which would help in making observations about these attributes. For example, an item relating to problem solving might be

'Does he think about what to do before taking action, or go ahead and try something to see what happens?'

You could try doing the same thing to find a list of 'things to look for' relating to the *concept of length*.

When your lists are complete compare them with the ones on pages 186 to 188.

Prepare a final list for one or all three (problem solving, curiosity, concept of length) by putting together your own and others' ideas with any you prefer from pages 186 to 188, and apply them before the next session to the child in your child-study. To do this you can either just tick those behaviours which the child shows, or make some comment about the degree to which each of the behaviours is shown.

Topic 4: Introduction to the check-list statements

The purpose in this topic is to introduce statements describing behaviour at different levels in development of certain characteristics as a means of summarizing observations about children.

Levels in the early development of problem solving

In the check-list for 'earlier development' three statements are proposed for describing progressive levels of problem solving ability:

- 1 Generally unable to approach a problem without help, or gives up if his first idea does not succeed.
- 2 Tries one or more ways of tackling a problem without much forethought as to which is likely to be relevant.
- 3 Identifies the various steps which have to be taken and tries to work through them systematically.

Now look at the list of 'things to look for' which was developed in the previous topic and applied to the child in the child-study.

Do you see a relation between the longer list of behaviours which you have used and the three statements above?

The three statements may be seen as a summary of the more detailed observations which were made using the longer list. So examine the observations you made on the child in the child-study and, in the light of the relation between the behaviours observed and the above statements, decide if the child can be described as being at one level or between two levels.

Now as you watch the video-tape on 'Problem Solving', or as you read the transcript, try to keep these three statements in mind and apply them to the four children who are shown.

It may be helpful to think of the statements as describing a

continuum rather than discontinuous 'stages'. Thus a child can be considered as being at any point in this continuum, i.e. between the levels described by the statements as well as at a particular level.

'Problem Solving' (*video-tape*)

*This video-tape shows extracts in which four children are working on the problem of building a bridge across the three supports (see page 35). They show various signs of being at different stages in developing problem-solving ability.

Commentary

Finding a solution to a problem often involves not one but several abilities and ideas. For example, the problem of supporting the object with the spills demands among other things some manipulative skills, patience, perseverance, as well as interest in finding a solution at all. Success may also depend upon keeping the nature of the problem in mind, being able to think of approaches which are likely to be successful, and being able to change to a different approach if one turns out to be unsuccessful.

The first two children we see working here on this problem are Aidan and Jane. Though they are working together it soon becomes apparent that their responses to the problem are quite different, so it is important to look at them as individuals and not as a pair. It would not, or course, be wise to form conclusions as to the problem-solving ability of either of them from this one instance, but we can look for evidence in the things they do and say in this situation which could be put with evidence from other situations in finding out their general patterns of approach to problems.

Aidan and Jane are trying to make a bridge between two supports by holding one end of a spill on one support so that the free end can take the weight of a spill resting on the other support.



* If you are interested in how and where the video recordings were made please see Supplementary Material, pages 198 to 200.

- AIDAN That's it.
 JANE Yea, we need one this end.
 AIDAN Ooh (*both a bit dismayed as the spills collapse*).

Aidan places a spill across to the third support from the middle of these spills.

- JANE That's a good idea.
 AIDAN It is, isn't it? Will give it more support, won't it?

Now they start again, giving attention to all three supports.

- AIDAN Use that one and . . . this.
 JANE I know, if we go like that, Aidan, that'll join there won't it? Put that there so that it joins, then that'll go in there.
 AIDAN Yea, then you can have this. But you're holding it, see? Yes, but you let go and it'll all come down won't it?

Jane continues placing spills across the supports to try to weight down the ends,



- JANE Put one . . . couple then, to hold it.
 AIDAN You need one here to hold it.
 JANE You need one here to hold it.
 JANE More than one.
 AIDAN Said we need a couple there.

He takes his finger off the support where he has been holding the spills on and there is a general collapse at his side.

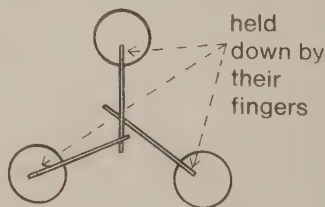
—Great!

- JANE (*who is still holding her side up with her finger*)
 Yea, but she didn't say nothing about us not being able to hold the ends!

- JANE I know what to do. You hold those two bits.

She directs Aidan to put fingers on two supports to hold the spills down and she puts her finger on the third.

- AIDAN What here?
 JANE And this?
 JANE No, that.



She places the object to be supported (egg cup) in the middle.

- JANE There we are . . . (*To teacher*) We done it (*giggles, as if admitting that it's not a serious solution, but she's just 'trying it on'*).

AIDAN Yea, but...

TEACHER You've done it. You're holding on to the ends though.

JANE I know, but if we let go it'll collapse.

TEACHER All right.

JANE But we got that (*taking off the egg cup from the middle and indicating the framework left*).

TEACHER Well, that's a good start. Now is there some way in which you could balance those so that you wouldn't have to hold them, with the egg cup on top?

AIDAN Yea, but we need one a bit longer (*picking out spill*). That's the longest one out of the whole lot.

TEACHER I see you found the longest one did you?

JANE Yea, to make it reach across there.

TEACHER I see, and what about the others—are they long as well?

JANE No, not as long. Maybe if we weaved it... sort of...

TEACHER Weaved it, that sounds a good idea. Yes, have a go at that.

AIDAN Weave it?

JANE Yea, put it like that...

She starts to lay out spills on the table in preparation for weaving.

AIDAN Weave?

Both are now busy trying to weave the spills into a mat—each working separately on the table beside the supports.

JANE I know what we could do. If we make this a sort of stretcher for the thing. Look. And we put it there.

She places the egg cup in the middle of the mat she is weaving from spills. Then she returns to the supports to find some way of fixing the mat on them.

JANE Aidan!

AIDAN That's my name.

JANE Has that come out? (*to herself*)

She fixes one of the supports back in place.

JANE Aidan!

AIDAN Yea.

JANE Nothing. I was just thinking... (*goes on weaving*) See, look, Aidan, (*taking her completed mat of spills to the supports*) now we need yours on the end of mine. I shall put that there. Aidan, get yours on now.

AIDAN Oh look at mine, it's all knackered up! (*he gives up*.)

Jane is extending her mat by weaving in more spills. Aidan sits with chin in hand watching her.

JANE (to herself) That's the wrong way again.

AIDAN I don't know how you've got the patience to weave like that, it's terrible, I can't do it. I get all ... you know.

JANE Agitated?

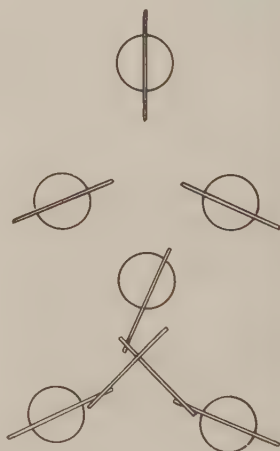
AIDAN Yea, I ain't got the patience.

Commentary

We saw Aidan and Jane give up the idea of counterbalancing and try instead Jane's suggestion of weaving, which she eventually put into practice successfully without Aidan's help.

Now we see Andrew and Mark, who work together to a greater extent but nevertheless show different abilities in relation to solving this problem.

Andrew and Mark start on their task with deliberation, making a balanced structure at each step. They first balance one spill on each support, and then adjust the balance of these so that more spills can be placed across. They say only a few words whilst doing this.



ANDREW Perhaps if we get ...

MARK No - I've done it, this side. I've rigged it up so that ...

ANDREW (Mumble)

MARK No, too much weight on that, so we need some ... there.

Places spill across free end of spill to counterbalance the weight resting on the other end.



MARK The further down it is ...

ANDREW ... the more weight it's ...

MARK Yea, so you hold two ready to go on when I put this one across here. Right? You have two ready.

ANDREW Two? (*holding them both at one support*)

MARK No, one on this one and one here (*indicating two supports*). Ready? As I do it you put yours on. Here we go. No.

ANDREW No. It seems to be supporting all right. Maybe if I put it like that.

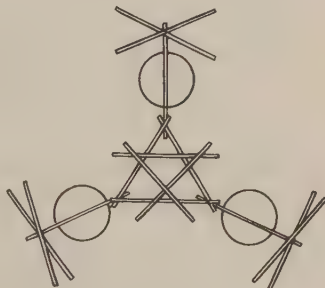
MARK Try it. Yes, that's an idea, have it just resting on the lip of that. That's it...

They delicately place spills across the central structure, counterbalancing with ones on the other sides of the supports.

ANDREW Shall I put another one?

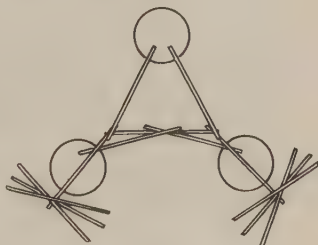
MARK Yea, put two on each.

ANDREW Hold on, hold on, hold on, got problems here... difficult.



They now have a structure like this:

MARK You see we don't want to make that too heavy, (*indicating the structure between the supports*) 'cos remember that's got to go on it. We want it just strong enough and all the rest are going to be used to support this. (*Pause*) That's it.



Their structure now is like this:

MARK Some more on these... A lot more on them... A lot more, right?

ANDREW What about the rest, aren't we going to use them?

Mark tests the ability of the structure to support the egg cup in the middle by holding it in position and just letting the structure take a little weight. They see where it begins to give.

MARK See that? That's there...

Andrew starts to put in a spill, weaving it into the existing ones.

MARK You're not allowed to use the base.

ANDREW I know, I'm not going to.

MARK (*Watching*) Oh, I see what you mean.

Commentary

Notice how they gave thought to how much weight the structure has to support and how they tested its strength without causing a complete collapse. Nevertheless they can see that this approach is not going to succeed and so they start again. This time only *one* end needs to be counterbalanced.

They have now started again after previous attempts were not succeeding.

MARK That's an idea. If we did... that. Like that... like that, one supporting one always.

He places three spills together so that one is supported by the others.



ANDREW And have lots of weight on there... at the end, d'you see? How's that one up, hold it up.

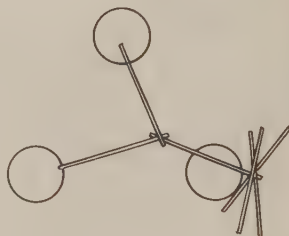
MARK That one's supporting that.

Now everything that's left's weight. (*mumbling*)

ANDREW Going to put all the weight there?

MARK Yep.

ANDREW It's worth a try, I suppose.



Commentary

When this failed to work they tried yet again, but once more with an approach involving counterbalancing. Eventually they came to realize that there was not enough weight for this approach to be successful.

They have just begun another approach, exploring the idea of starting with two spills for one support and weaving other spills in.

ANDREW ...can put that there though.

MARK ... underneath, then on the top... like that... then like that.

Now if we can somehow hold that in place.



He takes up the egg cup which the structure has to support and shows that it is supported with his finger holding down the spills at one point.

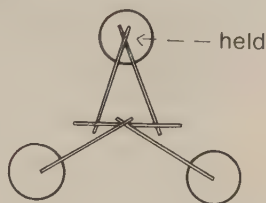
ANDREW Ooh...yes, but when you take your hand off...

MARK Yes, we've got to find some way to hold that down; we haven't got enough weight here to do it, have we?

ANDREW No...oh, well.

They look puzzled and the teacher arrives.

MARK (to teacher) We're having a bit of trouble here...



Observations about Curiosity

The check-lists give descriptions of three kinds of behaviour relating to curiosity. The first indicates that very little curiosity is observable, the second describes curiosity when it is at an immature level, and the third describes a more mature form of curiosity:

- 1 Often seems unaware of new things and shows little sign of interest even when they are pointed out.
- 2 Is attracted by new things but looks at them only superficially or for a short time; asks questions mostly about what things are, where they come from, rather than about how or why they work or relate to other things.
- 3 Shows interest in new or unusual things and notices details. Seeks by questioning or action to find out about and to explain causes and relationships.

Compare these descriptions with the 'things to look for' previously listed for curiosity and see if you agree about the interpretation of the different kinds of behaviour which is implied by the three levels. We do not want to suggest that curiosity necessarily develops from level 1 to 2 to 3; there are many reasons why this is often not the case. Development of attitudes is the subject of Topic 2 in theme B 'Children's Development and Learning' (pages 66 to 81) and of sections in *Finding Answers*.

Look at the observations you have made about the subject of your child-study, and decide what level of curiosity has been observed.

Levels in development of the concept of length

These statements relating to length come from the check-list for 'earlier' development.

- 1 Considers that things can change noticeably in length when moved from one position to another.
- 2 Correctly arranges three or more objects in order of length and confirms that changing position makes no observable change in an object's length.
- 3 Chooses a suitable arbitrary unit and applies it consistently for comparing and measuring lengths.

Again see what correspondence there is between the list of 'things to look for' and these summary statements about the concept of length. At what point in development of this concept is the child in your child-study?

Looking at the check-lists

The two check-lists which can be found at the back of this book are composed of statements describing behaviours at different levels in development of all the items which were identified previously as being relevant to learning science (see pages 181 to 186). Choose the list which is more appropriate for the children you teach, look at the comments on its intended use and read through the statements. Make notes about any statements which are not understandable or seem inappropriate. These will provide a useful basis for more detailed study of the lists in the next session.

Topic 5: Familiarization with the check-lists

The purpose of this topic is to become familiar with the contents and intended use of one or other of the check-lists and to review various ways of making observations about children.

After reading the introduction and comments about using one of the check-lists do you feel you have a clear idea of:

- what purposes the check-lists is intended for?
- what purposes it is *not* intended for?

If others have different ideas from you on these matters look at the check-list introduction again and identify the points which led to misunderstanding.

Work through the check-list statements discussing queries which you or others in the group have about their meaning or appropriateness. You may decide that some statements are ambiguous or unclear, in which case write in your copy the corrections you feel are necessary after discussion with others.

It may also be that the list of attributes covered by the check-list is not felt to be complete. If so, you may like to use the blank spaces

provided to extend the list by creating statements describing the development of the characteristics which you add.

As you read the check-list statements you may well wonder in what manner certain behaviours can be 'observed'. This is, therefore, a good time to be more explicit by what we mean by 'observing' in this context.

'What is observing'? (*Tape-filmstrip*)

[1] We have used the term 'observation' to describe the process of gathering information during the course of day by day interaction between a teacher and her pupils. [2] It must be already evident that what we mean by observation is far more than 'looking' but so far we have not been explicit about what the term is taken to include. [3] We think it includes all the ways a teacher can use to become sensitive to children's thinking and feeling. Five aspects of observation are picked out for discussion here, but there are certainly others which could be added. The five are:

- dialogue with children [4]
- questioning [5]
- listening [6]
- watching actions and working processes [7]
- looking at the products [8]

There is no one of these aspects which is sufficient on its own; each is limited but also makes its own unique contributions, so it is important to make use of all five.

- 1 We take *dialogue* [9] to mean an exchange of views in which the participants, in this case teacher and pupils, express their ideas freely, listen to each other and feel able to ask or answer questions. In these circumstances children are more likely to show how they think and feel about their experiences and to give the teacher an idea of their way of looking at things around them than if they are directly questioned. Questioning obliges a child to restrict what he says to answering the question, it doesn't encourage him to raise the points *he* would like to talk about. In order to help a child to develop new ways of thinking we have to find out about his existing ideas and knowledge and only he can tell us [10]. A discussion which is open-ended—that is, not directed to finding a particular answer which the teacher has in mind—enables a teacher to hear how children interpret events and what sense they make of certain situations. Whilst the children talk the teacher can listen not just to what they are saying but what it tells her about their reasoning, or their feelings, what intrigues them, what mystifies them [11]. She will

get some information about whether a child sees a problem to be the same as she does. If not, what is the difference? Does it suggest what influences the child's point of view? Does it help her to understand his thinking? It may even suggest how she can help him. If a child can talk freely and his teacher can resist the temptation to guide the conversation with probing questions, he will probably provide answers to questions which were unasked and ones the teacher might not have thought of asking.

In this book on pages 192 to 196, there are two examples of conversations between a teacher and a small group of children [12]. You might like to discuss them as examples of dialogue and give your comments on what each teacher is likely to learn about her pupils from the exchanges. Later you might also tape-record a discussion between yourself and a group of children, transcribe it and then criticize it in the same way.

- 2 The second aspect of observation was *questioning* [13], which inevitably plays a large role in teacher-pupil exchanges. It might justifiably be said that teachers do too much questioning, but we leave the subject of quantity aside at this point and concentrate on the quality of the questions asked. What kinds of questions help to find out how children view a situation, what understanding they have of the factors involved in a problem, what feelings they have in reaction to certain activities? For our present purpose, of finding out about these things, the questions are those which enable children to express ideas without fear of giving 'the wrong answer' and those which encourage them to give their reasoning for the statements they make. [14] We can call them 'open' questions, as opposed to 'closed' ones, which require the child to give the answer the teacher has in mind or simply to respond to her comments. Open question: 'What could happen to the wood when it is wet?' Closed question: 'Will the wood bend more easily when it is wet?' Open: 'What do you notice about these crystals?' Closed: 'Are the crystals all the same shape?' The 'open' questions are of most help to observation since they give children opportunity to reveal their thinking and their feeling. There is an interesting discussion in depth of questioning strategies to be found in the materials of the Ford Teaching Project.* In their materials distinctions are made between a variety of kinds of question of which the most relevant here is the distinction between 'subject-centred' and 'person-centred' questions [15]. The former ask directly about knowledge of the subject matter, for instance

* *Self-Monitoring Questioning Strategies*. Unit 2 Research Methods Ford Teaching Project. University of East Anglia 1975.

'Why does a heavy vehicle take longer to stop than lighter one?', whilst 'person-centred' questions ask about the child's ideas about the subject matter, for instance 'Why do you think a heavy vehicle takes longer to stop than a lighter one?' The person-centred questions are more effective as a means of gathering information about children's reasoning, and are to be preferred not only on this account but also because they are more likely at the same time to develop children's powers of reasoning than are subject-centred questions.

- 3 The third aspect of observation [16], listening, is obviously already involved in the two so far mentioned, but it deserves attention in its own right because we tend so easily to miss the information children give about themselves in talking. It may be missed for two reasons: in the first place we may not hear what the children have to say because we ourselves are doing all the talking; [17] in the second place, even if we hear, we may not attend to the significance of what is said. The first step which can be taken in finding out more about our children might, in some cases at least, be for the teacher to do less talking herself. The experience of making a recording of a discussion with some children will help to reveal whether this is a home truth in any particular case [18]. If it's found that only one child speaks between each time the teacher speaks, or if the teacher is cutting off a child before he finishes what he has to say, or completing his sentences for him, or putting words into his mouth and saying 'Is that what you mean?' then she's probably not taking full advantage of the opportunity to learn about her children. Less teacher talk gives the children a chance to explain how they see things, and to develop their logic. The teacher has more chance to listen and will find that letting the children explain themselves gives her more insight into their ways of thinking. You may find this point emerges from examining the transcripts of discussions given on pages 192 to 196.
- 4 Watching [19] the processes by which children carry out their work, as opposed to looking only at the products, is something teachers generally have all too little time to do. So much happens which is unobserved in the classroom, especially when the organization is informal. There is a great deal of action and talk which takes place literally behind the teacher's back [20], but whilst it isn't generally possible to listen at a distance it is possible to watch at a distance, noticing details of behaviour which signify that certain abilities or attitudes are shown in those particular circumstances. The observation of what the child does when not in contact with the teacher [21] is particularly valuable since it is as near as a teacher can get to finding out

what happens 'behind her back'. Observation of spontaneous behaviour enables the teacher to make inferences about children's co-operativeness, perseverance, responsibility and curiosity more usefully [22] than she can if she only notices behaviour when she is interacting with the children.

- 5 We have left the subject of looking at the product of children's work [23] to the last because it is a familiar and routine activity. We don't want to suggest that it is not important but we do want to stress that it should not be the only or even the main way of gathering information about children. If we want to understand the difficulties they have, and know about the way they work things out, then the product may give little hint of these things unless it is discussed with the children. Often what we call the 'mistakes' a child makes [24] give an indication of the stage of development in certain ideas which has been reached; in fact as far as the child is concerned there are no 'mistakes', for he has represented things as they seem to him [25]. For instance, is the lack of symmetry in one of these supposedly symmetrical patterns a 'mistake' or an indication that the child hasn't understood the meaning of symmetry? Again [26], in this 'sorting' the children have quite deliberately stuck the same piece of material in two, and in some cases three, groups. A mistake or a sign of being as yet at an early stage in ideas about classifying?

Although the five aspects of observation just considered [27] have not exhausted the ways of gathering information about children during their normal work, it is important to turn now to face some problems and doubts which surround the gathering of information by observation. There are two major concerns, the first being that no observation can be made objectively; it is unavoidably affected by the person who observes. The 'eye of the beholder' biases the information which is gathered [28]. We know from experience how two uninvolved bystanders can give different accounts of a traffic accident, and how the versions given by those involved are likely to be even more at variance. Our expectations, our intentions and our mood at the time all influence the information we get through our senses. So a teacher, involved with her pupils, is not able to be objective about their behaviour [29] and we are not assuming that she can be. Admitting this is an important initial step in guarding against the distortion it can give rise to; but there are other things which can be done to help which we'll look at after raising another important influence on what is observed.

The second point [30] concerns the particular set of circumstances which exists at the time of making the observation. Andrew

shows tremendous perseverance in building his model but very much less when working on his mathematics [31]; Julie is normally quick to see patterns and relationships [32] but she had unexpected difficulty in grasping the idea of animals being adapted to their habitats. The interest a child has in a particular activity, his motivation to succeed, how well he feels, whom he's working with, —all these, and more, will affect his behaviour on any particular occasion. Therefore inferences from any one observation can be drawn only in relation to the circumstances operating on that occasion.

[33] It follows that if we want to make inferences about children's development from observation of what they say and do, then it is safe to do this only if a number of observations are made on different occasions. The inferences made each time add to the information which a teacher uses in deciding how to respond to a child; they build up a dynamic picture of the child, an image which is continuously modified as events and the child change [34]. Obviously it is impossible to maintain a written record of this changing picture and daily observations are recorded for the most part mentally.

Building up a picture from a number of observations also helps with the first problem raised, the lack of objectivity of any one observation. A further step which helps here is to have some criteria for making inferences from observations and to keep to the same criteria on all occasions and for all children. Thus, if we are making inferences, say, about a child's development in 'ability to apply learning' then we should be quite clear about what we shall take as signs of this ability being present in varying degrees. This is what the project has tried to do in providing the checklist statements [35]. The check-lists may help to reduce the subjective element in observation but will never eliminate it. But we should remember that all methods of gathering information about people's abilities are subjective to some degree—even so-called 'objective' tests.

However if we recall the purpose of making the observations we see that the limitations of reliability which have just been discussed need not be a great cause for concern. The purpose is to enable a teacher to find out about a child's way of thinking, and reasoning and feeling, so that she can make sure his experiences encourage the development of his thinking, reasoning and feeling. [36] The information is gathered *by* the teacher *for* the teacher to use; it will most often be used immediately without any record being made, but when a record is made this, too, is for her own use as part of her teaching strategy. In this context the issue of reliability is much less important than if the observations were used to select or to grade pupils.

Observing varying kinds of behaviour

You may now like to try to decide which kinds of observation are most useful for gathering information about the characteristics covered by the check-lists, i.e. to try to complete this kind of table:

<i>Check-list items</i>	<i>Source of observation</i>				
	Dialogue	Questioning	Listening	Watching processes	Looking at products
Observing					
Raising questions					
Exploring					
Problem solving					
Interpreting findings					
Communicating verbally etc.					

Developing skill in observing

People vary in the use they can make of observation because this will depend upon skill in asking certain kinds of question, establishing a particular atmosphere, being sensitive in noticing various behaviours, and so on.

You may or may not feel your own skill in observing is satisfactory; it is difficult to know without being able to look at oneself more objectively. This is why we have suggested making a tape-recording of yourself talking with children. But you might start by looking at the examples on pages 192 to 196.

- 1 First read the two transcripts of conversations on pages 192 to 196. The questions which should be asked about these are:

- are the children able to talk about what they feel is interesting?
- is the teacher leading them to any conclusion which is already in her mind?
- does the teacher talk too much?
- are there signs that she really listens to the children?

- does she ask more ‘open’ or more ‘closed’ questions?
- does she frame questions to be ‘subject-centred’ or ‘person-centred’ in general?

- 2 Tape-record a conversation between yourself and 2 to 4 children on a topic which is a part of the children’s current work. Transcribe the tape—or at least five minutes of it, if you have not the time to do more. Now ask the same questions as above about your conversation.

If you are not satisfied that the conversation gives the children chance to explain their view of the subject, then try to identify aspects of your own speech which may have prevented this. You might like to repeat the process of recording to see if a conscious attempt to change your interventions has had any effect.

- 3 On pages 204 to 213 there is an account of observations made by a teacher about the work of two children over a period of two terms. As you read it consider what the teacher is learning about the children. You might like to see how the evidence from the observations relates to the items on the ‘Earlier’ check-list before turning to the notes made by the teacher which are given at the end of the account.
- 4 Finally, bring some examples of your pupils’ work and discuss them together with examples brought by others. What do these tell you, not so much about what the children know, but about the way they think about the problems on which they have been working?

Now apply the whole check-list, with any modifications you may have made, to the child who was the subject of your study in earlier sessions. It will be helpful to have this ready for the next meeting.

Topic 6: The value of making and recording observations

The purpose of this topic is to reflect upon the value of making structured observations and to become familiar with some of the uses that can be made of records of such observations.

First reactions to using the check-lists

The first attempt to use one of the check-lists reveals many practical difficulties which you will want to discuss with others before going further. You will soon find that you are not alone in finding problems! It shouldn’t be expected that using the check-list will make observation

easy or will change things overnight; it takes time and indeed some effort before the criteria become so much internalized that one does not have to be consciously reminding oneself of them. In the Supplementary Material (pages 201 to 204) one of the Project team describes how a small group of teachers in an Infants School tackled some of the early difficulties of observing development of concepts. Other teachers who have used the check-lists report that they prefer not to set out with the intention of looking for development of a particular attribute, but rather to look carefully at what happens and to try to interpret it in the framework of the check-list statements.

Are records needed?

Before taking up the subject of making any kind of record of the observations it should be stressed that the *use* of the information is the prime purpose for gathering it. Records are only of relevance if they serve this purpose. *In the present context we are not concerned with gathering information in order to keep records, but only to keep records which help us make better use of the information gathered about the children.*

On the vast majority of occasions what is learned about the children by observation is used immediately and no record is made, but there is value in bringing together certain information about a child to make a record, at regular but not frequent, intervals:

- a record enables a profile to be constructed, showing where a child has strengths and weaknesses, and suggests in what respects he may particularly need help,
- a succession of such records shows the rate of progress in developing various abilities and concepts,
- a record enables a teacher to reflect upon the effect on her pupils of the learning environment she has provided.

Records of individual pupils

What record did you make as a result of applying the check-list to the child you have studied? Compare the method you used for recording with the record made by others in the group.

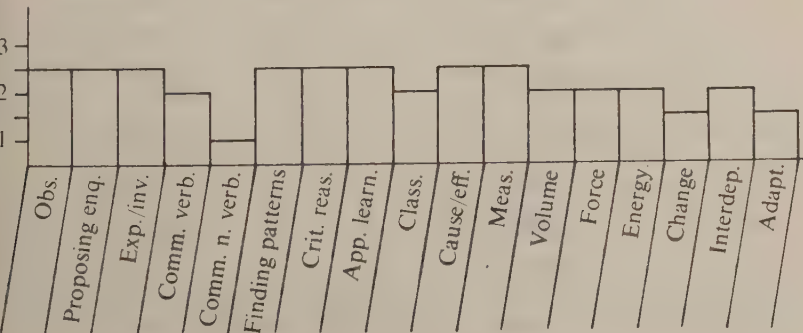
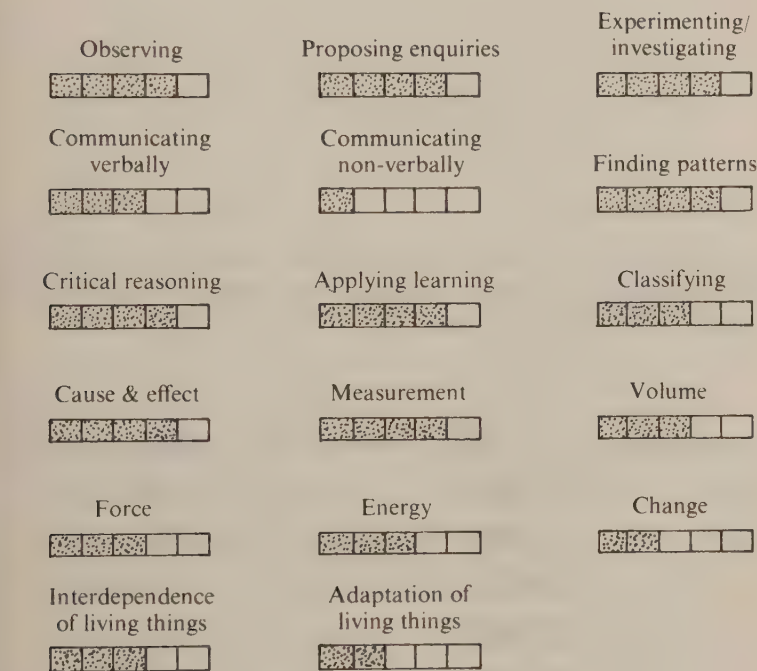
The check-list suggests recording the position in development of each attribute along a horizontal row of boxes.

This has the advantage of avoiding a numerical record which might be interpreted too literally. We would not want a child to be recorded as

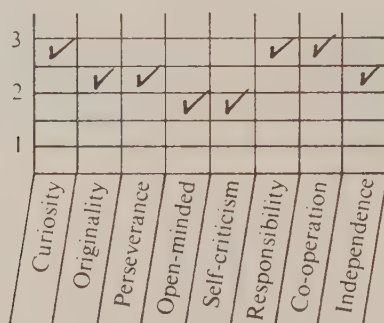
2 for observing
3 for defining problems
1½ for identifying variables etc.

since these numbers might too readily be interpreted as 'marks'.

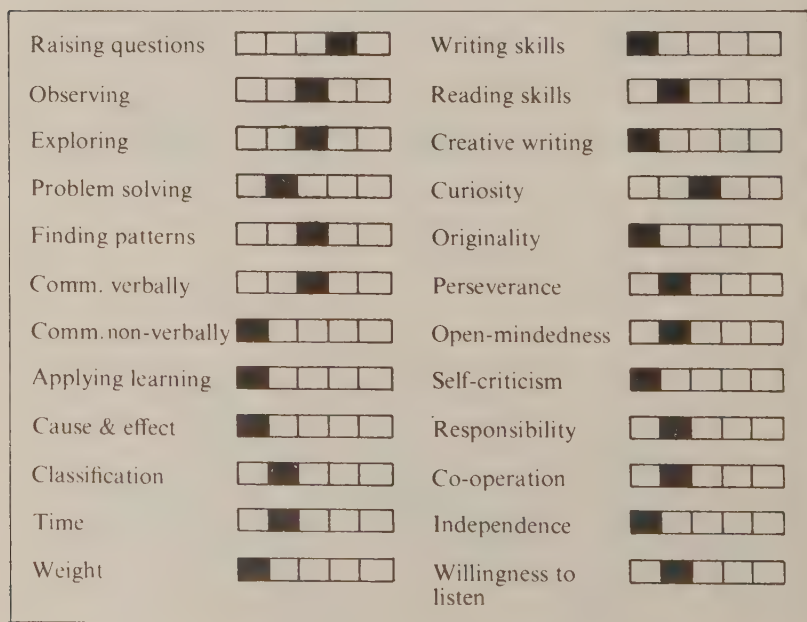
There is a danger in using the boxes, however, that the equal spatial intervals between 1, 2 and 3 will be interpreted as equal intervals in development. This is *not* the case; the relationship between the three statements is restricted to one of supposed order, i.e. 3 indicates further development than 2, and 2 more than 1 (in mathematical terms the statements for each item form an ordinal scale, not an interval scale). Apart from this reservation teachers have found the boxes give an easily grasped record. They can be laid out like this record of Benny (see page 29),



or as a block diagram, which provides a ready profile but unfortunately invites quantitative interpretations which are not valid:

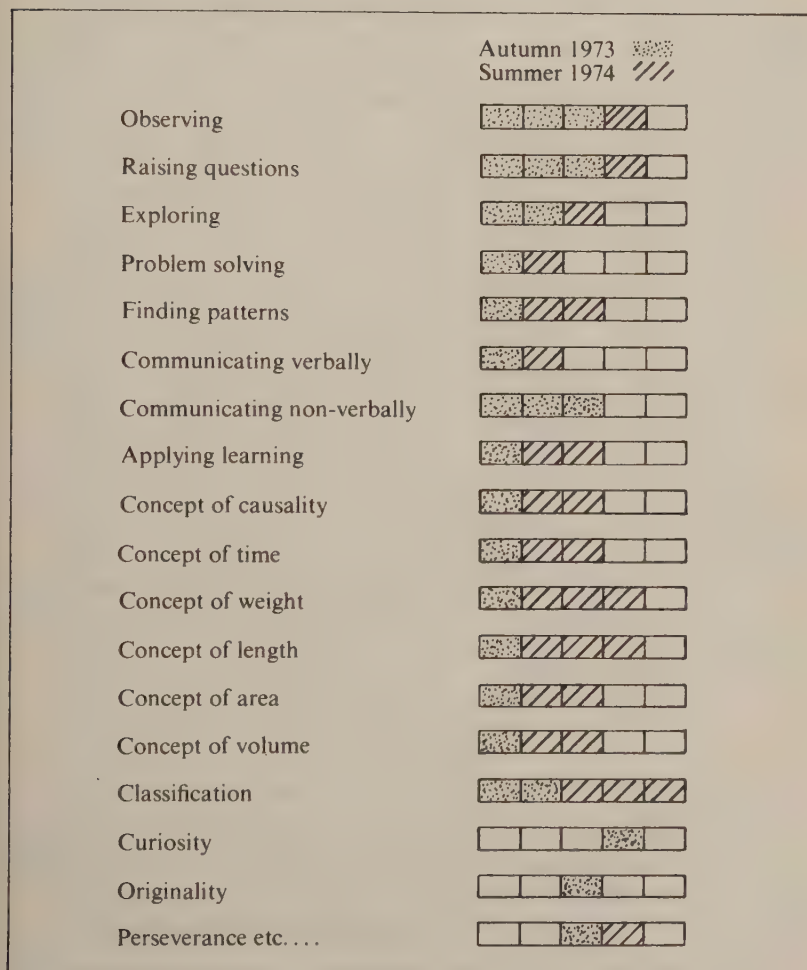


The following record was built from the 'Earlier Development' check-list with items added so that it covered more of the learning of children in an infants' class:



Cumulative records

Any one of the methods for keeping records graphically can be used to keep cumulative records in one place, so that progress can be seen. For example this shows the progress of Simon from Autumn 1973 to Summer 1974 (see pages 10 to 13):

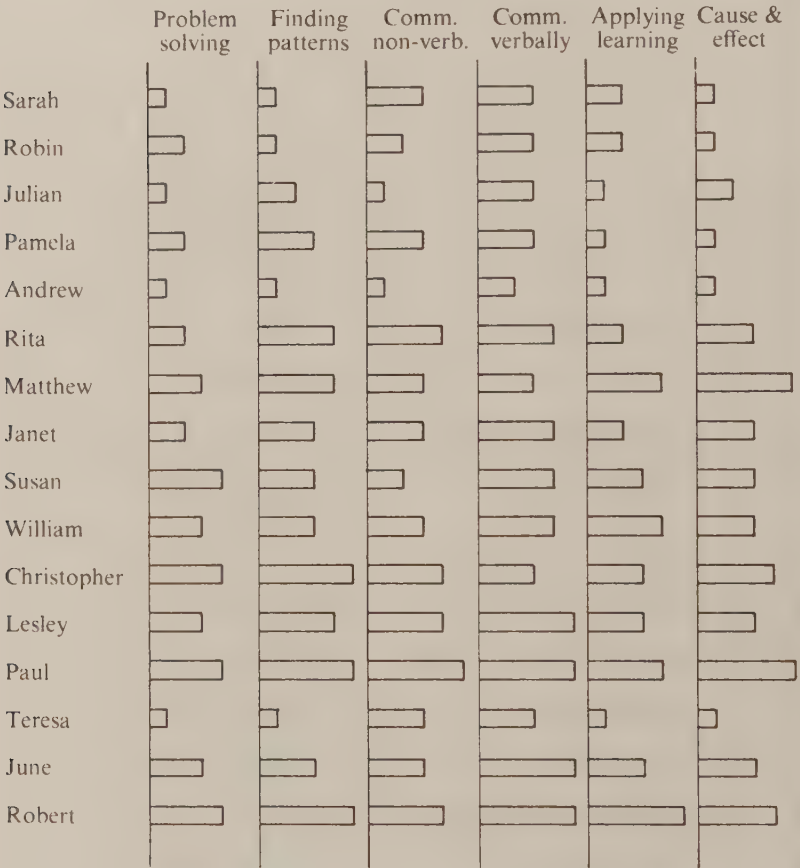


Whole class records

The labour involved in making records for every child in the class is not underestimated, but it may be more than compensated by the informa-

tion it gives not only about each individual but about the patterns of progress in the class as a whole.

Extract from a record of children in a family-grouped Infants' class



The children are listed here in order of age, and some of the patterns are obvious. More important than the patterns are the exceptions, the children who might be assumed to be more or less advanced in development, on account of chronological age, than careful observation reveals to be the case.

Extract from cumulative records of a class of 7 to 9 year olds

The teacher of this class expected that the work in the time between the two records would have helped the children's progress in all the

	Observing	Raising questions	Exploring	Problem solving	Finding patterns	Communicating verbally	Communicating non-verbally	Applying learning
1(B)								
2(G)								
3(B)								
4(B)								
5(G)								
6(G)								
7(B)								
8(B)								
9(G)								
10(B)								
11(G)								
12(G)								
13(B)								
14(B)								
15(G)								

B = boy; G = girl = initial observations = 1½ terms later

items. What can she learn from this record which has relevance to her methods? Were children of all abilities having opportunity for progress? Were boys and girls making similar progress?

How does the observation help the child?

The test of the value of all that has been proposed—observing and using check-lists—lies in whether or not it helps a teacher to know her pupils any better. Knowledge of the child's ways of looking at things, of his abilities and of his feelings helps a teacher to 'get through' to the child more easily and suggests the experiences which will help

his learning. There is, of course, more to providing 'matching' experiences than increasing our knowledge of the child, and this complex matter is the subject of a separate theme. But knowledge of the child is the foundation on which decisions about the learning environment have to be based, so the question should be asked: does structured observation increase a teacher's knowledge of the children?

Look back at the first notes you made for your child-study. Do you feel you know more about the child as a result of the observations you have made?

Do you think the process will have helped the teacher? Has it resulted in benefit for the child?

Theme B: Children's Development and Learning

Topic 1: Exploring children's thinking and feelings

The purpose here is to examine the consequences for learning of different children's reactions to the same experience, and to recognize some of the differences between individuals which affect their reactions.

When we provide experiences for children it is very likely that each child learns something different, that is individual to him in some respects. What has gone before, how he feels at the time, how able or interested he is—these are only some of the things which affect his reaction to, and what he gains from, each experience.

It is not difficult to see that the Friday afternoon swimming session is a different experience for these two ten-year-olds:

'Swimming.

Ough! Sometimes I really wish swimming didn't exist. Cold almost freezing water. It's bad enough carefully climbing in, jumping or diving must be horrible. You would surely catch a cold or something and five minutes is bad enough half an hour is horrible. It wouldn't be so bad if I went once a year but once a week is unbearable. When I go swimming with our school all summer it gives Friday afternoon a bad name and in the winter it's the best of the week. I would rather do maths than swimming. I just hope we don't do it next summer. It's one of the worst things in the world.'

'Swimming.

I feel great when I'm in the water. It's a bit cold when you get in but you soon get used to it. I like going under the water but I don't like getting it up my nose. I can almost swim a whole width under water without coming up to breathe. It takes the weight off you when you're in the water and you can do things like summersaults that aren't so easy to do outside. Sometimes I like to go fast through the water but it's nice to go lazing about when there's not many people there. Nobody really taught me how to swim, I just had some instructions and then I did what I wanted.'

Here the different reaction to a physical experience is very obvious and equally obviously it affects their learning—no prize for guessing who is the better swimmer! In the classroom the symptoms of children's different reactions may be less evident but nonetheless powerful in affecting learning.

What things affect reactions to new experiences and the learning which can take place?

As a start we can look at our own reactions in the following situations.

1 What's in the tin?

You are given three small tins, A, B, and C, with tightly fitting lids. Without taking off the lids try to find out all you can about what is in the tins. Are they the same? Is there one with nothing inside? Try to give reasons for your suggestions about what they contain. Do this first of all without discussion with others, and put down what you think. Compare this with what the rest of the group have put down. Does this make you change your mind at all?

Now you can look inside!

Whether you were nearly right or not, think about how you felt in this task. What affected your ability to give an answer and a reason in the case of the tins? Put down anything relevant whether it is about the task or yourself, or the situation, or other people around. Share your list with others in the group and add to your list anything new which is suggested.

2 Finding out about Keets

Someone has just told you of the existence of keets, so you go to a reference book to find out about them and this is what you find:

Keets are intriguing and useful objects because they are keetic. Some occur naturally and many are man-made. It is thought that ancient man may have used them for gathering sticks but since they rot away in most climates there is no firm evidence of this. Natural keets are made of the rare hip-wood. Some other materials can be made keetic if they are brought up to a keet in a special way; they must point towards the moon and be rubbed together in a circular movement. In this way keets can be made from telams, staclips and ferns. When two keets are brought towards each other a low pitched note is heard which rises in pitch as they come closer together. The noise can be arrested by placing a thick piece of wood between them, so keets are always packed in wooden boxes with separate compartments for each. Keets gradually become less keetic if they are exposed to noise so it is important not to speak too loudly, and especially not to sing, when close to them. Several small keets can be made into one large one which will be as loud as all the small ones separately. Keets are used in the trilling industry for tuning instruments and for measuring distances.

Can you now answer these questions about keets?

- do they occur naturally?
- what can they be made from?
- when do they make a noise?
- what changes the pitch of their note?
- and so on.

You probably can. But do you have any idea of what a keet is? If not, try to decide why this is so.

Perhaps you may find some items to add to the list of things which affect the learning which takes place.

Perhaps you think that keets are too fantastic, but only because you have the wider knowledge than a child to know that they cannot be real. A child, who is without this knowledge, is in a very different position, and keets are then no more obviously unreal than, say, lasers. Imagine how a child reacts to the information from the *Children's Britannica*:

From an ordinary light source, such as a lamp bulb, light streams in all directions, just as when a stone is thrown into a pond and ripples radiate outwards in ever-widening circles, becoming fainter as they go. This kind of light is known as incoherent light, that is, it does not cohere or stick together, but spreads all around. But in the laser things may be so arranged that all the light comes out in the same direction. This kind of light is known as coherent light. If the light is concentrated like this into a very narrow beam, the source appears extremely bright. The most powerful laser sources are brighter than any others that can be made—in fact they are much brighter than the sun.

(*Children's Britannica*, Vol. 10, p. 174. 3rd edition 1973)

We have listed so far what affects our own reactions, but this is only a preliminary to considering the factors which will affect children's learning from new experiences. Is it fair to project our own feelings and thoughts on to children?

The following is transcribed from tape-recordings of children talking whilst trying to solve the problem of the tins.

Dennis and Lesley

- LESLEY We're not going to work together are we? Oh... that doesn't give me a chance.
- TEACHER There's something for each of you to do. Don't take the tops off but do anything else you can think of to try to find out what's inside the tins.
- LESLEY Can we write down the facts?
- TEACHER Yes, that's a good idea.
- DENNIS Need an X-ray camera, like they do in...

LESLEY I think I know what this is. Can I keep it secret from the others? (*She writes, guarding her paper from Dennis's view.*)

TEACHER Well, it might help if you discussed with the others.

Both are rattling the tins vigorously.

DENNIS Well to start with there's only one in this and it's fairly big.

TEACHER What makes you think there is only one thing in it?

DENNIS (*Turning to another tin.*) Now that is full of a powder of some type.

TEACHER Is it quite full?

DENNIS Fairly full—'cos it's not rattling about much. They're all pretty well full.

LESLEY What do you call those things...

DENNIS This one's got...

LESLEY Dennis! Do you know those things that are about that big and are sort of split in half and go all wobbly...

DENNIS Jumping beans.

LESLEY No, not jumping beans.

DENNIS Monkey beans.

LESLEY NO! (*angrily*) Well, I'll just draw a picture of it.

DENNIS I think there is definitely, inside this, something—the thing inside has something also which is inside it. When you rattle the thing inside you can hear it rattle but the outside isn't moving.

LESLEY I think there's two in that and one in that. Just a minute (*goes to write it down*). I know, let's try rolling them.

DENNIS It's not going to make any effect unless it's a liquid, 'cos if you put water, if you put something half-full of water inside a tin it won't roll—or syrup.

LESLEY Oh gosh... do we have to...

DENNIS Can I see that—sounds like marbles to me. It's one marble. (*Now handling three tins*) I think this is sand.

TEACHER What do you think about that one, Lesley?

LESLEY Sand, but I think that—is that, and I think this is two marbles.

TEACHER What makes you think it's two?

LESLEY Oh—(*with exasperation*) I don't know how to put it.

DENNIS I think this is the jumping bean (*tries rattling again*). No, no it isn't, it's a marble, a marble, almost certainly.

TEACHER Is that the one that was rather wobbly when you rolled it?

DENNIS This, this has two marbles in it. It's something heavy, and the marble is so heavy compared with such a small place, and if there's two of them there's not enough to

- give them much space and when they get to a certain place where they can't go...
- LESLEY Do we have to go on with this?
- DENNIS ... on they jump over.
- TEACHER So you think there are two in there?
- DENNIS No, two in here and one in here (*taking one tin from Lesley*). Can I have it please?
- LESLEY (*Faint murmur of discontent*)
- TEACHER What's the trouble, Lesley?
- LESLEY It's a bit boring...
- DENNIS Look that's the jumping bean, it's the jumping bean that does the wobble. The thing inside it is making it drag, because you've got the bean coming down there and the thing which is inside of it coming down there...
- LESLEY I can't do it, I'm no good at this sort of thing.
- TEACHER Don't you like problems like this?
- LESLEY No.
- DENNIS ... which will almost certainly make it wobble.
- TEACHER Do you enjoy working on problems like this, Dennis?
- DENNIS Yes, I do, 'cos you have to think out some—well the obvious thing if you want to find out is to look at it, but if you can't look at it then this creates problems and you have to think...
- LESLEY I've decided. This is sand, that is a marble and that is a jumping bean, or whatever you like to call it.

Children will often talk freely about their reactions to the events and organization of their everyday work revealing more of the factors which influence their learning. Here is eight-year-old James, a bright child according to his teacher, talking about some of his likes and dislikes.

- JAMES I don't like it when she says it's not clear enough and you have to do it all over again, and when she says 'That was bad', in front of all the class.
- W. H. Well how do you prefer to be told when things are wrong so that you can put them right?
- JAMES I don't mind if she tells me it's wrong, but not if she tells me to put it right. I don't like correcting things, 'cos I know what's wrong, but I do put it right if she says so. One thing I don't like is, 'cos I'm good at some subjects she thinks I'm good at others, and I'm not really. I'm not—like English.
- W. H. You're not very good at it?
- JAMES I'm not very bad at it, but I don't like it.
- W. H. I expect there are some parts you like more than others?
- JAMES I don't like English from books. It's boring and it's easy.

You know, you have to write sentences that you don't really need to write. She knows I'm good at those things, and when I do them correct she doesn't, er, do any compliments. I don't like it.

W. H. Which is a subject you do like?

JAMES I like, I think I like history.

W. H. What is it that you enjoy about history?

JAMES Well, it's interesting. But I don't like it when she puts up questions on the board. Because she underlines part of the word and you just have to write it down. I don't mind that, but sometimes we have to write the whole of the question and the answer down, because of the others who can't answer questions quickly, or just put one word and the teacher doesn't know what they're talking about. All the class do the same.

W. H. Do you like it when you all do the same or when you work on your own project?

JAMES I prefer working on my own project. You see, because my thoughts aren't the same as other people's. I don't like doing a project with a lot of people, I like doing my own projects. 'Cos I don't always agree with their work.

W. H. Do you like to work near other people?

JAMES I like having them around, but I don't want them to be noisy and I like doing my own work—without, you know, anyone else. And also when I work with some other people, like David Smith, say, I do all the work, they just copy.

W. H. You have a different teacher for maths, don't you? Tell me about the things you like when she is there.

JAMES Well, I like the way she sets me interesting work. But I don't like the way she shows you up for the things you've done wrong in front of everyone.

W. H. Do you all have the same work?

JAMES No, I work with David. Sometimes I work on my own. I do most of the work with David because he doesn't have very good ideas. The groups do different work most of the time. (Pause) I like Mrs. T. because she doesn't get you to do everything correct, 'cos I think it's better—you see, you learn from your mistakes, you don't learn from correcting them.

W. H. Can you explain that to me?

JAMES Well, when you know your mistake there's not much point in writing it all over again. Some people have to write it down, but I don't think I do, really. But I don't like Mrs. T. sometimes, because she calls you over and asks you what you're doing, and you may be—you

know, she says 'No, you mustn't do that' and she doesn't really understand what you are trying to do.

An older child, Martin, who is eleven, sees more of the advantages in working with others, and seems to appreciate the working atmosphere his teacher provides:

W. H. What's the kind of work you enjoy most?

MARTIN When you really have to think about things or work out—not like looking up things in dictionaries and doing things you already know. It's one of the reasons why I prefer maths from any other subject.

W. H. Do you like working alone or with others?

MARTIN It depends on what the work is. If you're working in a group of three, and you have three people's different ideas, it's difficult, well, er, to know what to do. Science, though, is much better if you've got a partner because in a lot of cases the other person may have had an experience or come across a case which might help you to discover what you're trying to find out.

W. H. How do you like your teacher to help you if you've gone wrong?

MARTIN I think rather than saying 'That's wrong' it helps, er... it depends in what situation. If it's science it's best to find out where you've gone wrong, and in mathematics as well. In quite a few subjects it's more helpful to know where you've gone wrong than to be told that it's wrong. It helps if she says 'Well, look through that again' and then you find out what your mistake is. It depends what—there are some mistakes that are all part of learning.

W. H. So you don't get told off for making mistakes?

MARTIN Well it depends what kind of mistake, and it depends on which person it is. Because instead of judging on a standard she judges from what the person is capable of doing. 'Cos if it's somebody who's got really bad writing and they do quite a reasonable piece of English that may not be quite up to the standard of other people, that person has tried and the teacher says they've done well even if it's not as good as somebody else's. And I think this is much fairer.

W. H. You don't mind if somebody whose work is not as good as yours gets praised more?

MARTIN No, because, I mean, some people who've got bad writing, though they tend to get slightly nagged all the time to try and get it better, if they do something well for them they get more praise.

W. H. Do you compare marks?

MARTIN No, I don't like this, especially as it depends how it's er, judged. I mean, because, when I was in class 3 we were split into tables, and when Mrs. F. marked them it was easy for the top table and they always got the bars of chocolate at the end of term. Competition isn't good, because it's often how good you are, not how much you improve.

Make notes about anything which you consider is evidence of the influence of certain factors on the children's reactions. It is, of course, not possible to be sure of what was affecting the children, but we can make inferences based on the evidence of what the children say. Here, as in other cases where we attempt to interpret behaviour, *it is important not to confuse what is inferred with what is observed*, and to make sure that there *is* some firm evidence for the inference that is drawn.

The inferences based on the reactions of the children quoted here enable some of the possible influences on children's reactions and learning to be listed. To these, more points can be added from experience of other children in other situations. How close are these to the points listed from considering your own reactions to the problem of the tins on page 60?

In the next topic we shall be taking up the subject of attitudes which may influence learning. It will be useful to observe children's responses to a particular situation and to consider what personal characteristics and attitudes of children may (by inference) account for their different reactions. Perhaps the three tins or a similar problem would provide a focus for your observations.

Topic 2: Attitudes and how they develop

The purpose in this topic is to heighten appreciation of the important effect of attitudes upon learning, and to further knowledge of the pattern of development of attitudes.

Among the factors identified and discussed in Topic 1 as having an effect upon our response and performance to a particular problem there are likely to be a number which can be grouped under the heading of 'attitudes'. These are the ones which are the subject in this topic; we shall return to the effect of other kinds of factors in later topics.

Many different definitions of attitudes can be found, none being universally agreed, but what they have in common is a description of an attitude as being

... a predisposition (a set or preparedness) to react in a certain way to particular objects, persons or situations.

The importance of attitudes is made clear in these words quoted from K. M. Evans' book entitled *Attitudes and Interests in Education*.*

Ask a boy what he learns at school and he will tell you English and Mathematics, History and Geography, Science and Languages. But his teachers, if not the boy himself, will know that he learns far more than this. Modes of thinking and acting, attitudes and interests are also acquired and developed during these school days, and these may become permanent, remaining effective and observable long after the greater part of the subject matter learnt has been overlaid or forgotten.

It would be difficult to overstress the influence of attitudes and interests in the lives of individual people. They determine what a man will do or say in particular situations, what he will enjoy or dislike, his approach to other people, and his reactions to events in his own life and in the world around.

Attitudes can be grouped and classified in many different ways, but if we confine ourselves to those relevant to children's learning we can perhaps simplify the picture by considering attitudes of three kinds:

- towards self,
- towards others,
- towards objects and situations in the environment.

Problems can arise if we try to tell others what attitudes they should have (e.g. how they should value certain experiences or even certain people), but we can steer clear of these conflicts if we keep to those attitudes which are agreed as beneficial to a child's self-image and learning.

Do attitudes towards oneself affect learning? (audio-Tape)

As a start in the discussion of whether or not attitudes of various kinds affect the way we and our children learn it is useful to recall how you felt when presented with the problem of the tins. Perhaps you thought:

'Oh dear, I'm never any good at these sort of things, I hope I don't make a fool of myself.'

or 'I've done this kind of thing before, so at least I know where to start.'

or 'It's clearly impossible, there really isn't much point in trying.'

Or possibly you waited to see what other people did and then joined in. These different reactions not only affect what we do in such situations but also our likelihood of success or failure. Past experiences, our own expectations of our ability to tackle the problem adequately, our willingness to try, and not least the

* *Attitudes and Interests in Education*, p. 1. London: Routledge and Kegan Paul, 1965.

expectations of others—all these will probably have some part in determining our reactions. If we believe that the task is possible, and feel that we are capable of doing it, then it is likely that we will have more chance of succeeding. Or, in the reverse, if we don't believe we are capable of doing something and feel we can't, there is more chance of failure. Our behaviour, and performance will be affected by the feelings and beliefs we hold about the activity and about our own ability with regard to it.

In the same way, what a child can or cannot do is strongly influenced by what he feels he can do. If he feels and believes he is capable of success, he is more likely to succeed; whereas success is less likely where these beliefs and feelings are lacking. If his attitude to learning is positive, he is likely to put more effort into it, which brings satisfaction, success and achievement. So his attitudes are likely to affect not only his learning, but also the effort he puts into it and his resulting achievement. If this is so, and attitudes play such an important part in learning, we should consider how it is that the child develops these attitudes.

A child's attitudes to things outside himself will largely be determined by his own attitude to himself. His own feelings and beliefs about himself affect how he behaves towards other things, and colour his attitudes about them. But how do his attitudes to himself develop?

Very simply, the child's beliefs and ideas about himself are formed as a result of the approaches and treatment he experiences. The picture the child has of himself grows from comments made by other people and from the inferences he draws from his encounters with them at home, school and in social groups. He gradually builds up a picture of what he thinks he is—his self-picture. This is made up of three parts.

Firstly what he thinks he is in relation to others; it grows from these sorts of comment made about him...

'You help me, John. You're taller than Peter.'

'Mary is better at cutting than you, but then she is older.'

Secondly he gradually becomes aware of a picture of himself as others think he is, which develops from these sorts of remark:

'You can paint the frieze, because you are good at painting.'

'You can't have that. It's delicate and you are likely to break it.'

The third part of his self-picture constitutes what he wishes he was, or feels he ought to be, which he shows in such remarks as:

'I ought to be less clumsy.'

'I ought to be more helpful.'

These form the total picture he has of himself:

- the picture of himself in relation to others,
- the picture of himself as others see him,
- the picture of himself as he wishes to be.

and it is this self-picture which influences and determines the child's attitudes to so many aspects of his work and experience. If he has ideas about himself which are in tune with how he thinks others see him, and how he wishes to be, then his attitudes will be positive, he will approach new experiences with confidence, be willing to experiment and be likely to make a success of his efforts.

It may be that his self-picture, what he thinks he is, is very different from what he believes others think he is, and from what he would like to be. He may feel that he does not compare favourably with his peers, and that others see him as 'no good', and as a failure. If this is the case, he is likely to have a negative self-picture and negative attitudes to many things. He will feel sure he is inadequate and unsuccessful and these attitudes will lead in turn to failure. A vicious circle is created.

The child thinks he is no good,
therefore makes little effort.

Failure results from this lack of effort
which reinforces his feelings that he is 'no good'.

The child's negative attitudes to learning are more likely to influence his success or failure than his actual ability. If he thinks he can't do something, then this will override his ability to do it.

A negative self-picture in turn leads to a lack of self-confidence, an unwillingness to try new activities and a lack of faith in himself and in others. But the position is not hopeless. As we have suggested earlier, the self-picture is learned—as a result of experiences and encounters—and if it is learned, we can do something towards fostering a positive attitude in our pupils.

What attitudes?

Remembering that we are considering attitudes to be those attributes of a person which determine how he reacts in particular circumstances, try now to suggest the attitudes which you think affect responses to problems or situations where one has to find out or work things out for oneself? (Take the three tins as an example, but consider this as one of a wider range of situations.)

Jot down your ideas:

e.g. concentration, initiative, confidence...

We now take *one* of these as an example to study in more depth.

Probably your list contained 'perseverance', or something meaning much the same thing—persistence, sticking power, etc. The following outline of points about the nature, development and encouragement of perseverance is taken from *Finding Answers*, pages 36 to 43 where further explanation and examples to illustrate the points made can be found.

Perseverance

What is it?

It has two main aspects:

- the tendency to continue in an activity or task once it has begun despite difficulties or opposition,
- changing one's method of carrying out a task to suit a change in conditions.

Does this accord with your understanding of perseverance? Is it too narrow or wide a description? Do you think perseverance is always a positive thing, i.e. worth encouraging in all cases?

Why should we encourage perseverance?

Reasons proposed are:

- children will meet problems which cannot be solved at the first attempt and they should be encouraged to try again and to try different approaches,
- once a problem is overcome through perseverance the feeling of success and achievement encourages a child to persevere in future,
- it assists intellectual development (see later topics in this theme) if children stretch their abilities to overcome difficulties and extend themselves to do more than can easily be done at the first attempt.

There are also some words of warning

- children can benefit and enjoy activities without conquering every difficulty,
- some kinds of perseverance are unproductive, when repeated efforts lead nowhere.

In what other ways do you think perseverance helps/hinders pupils in their work? Is it worth while to try to encourage it in all pupils? Should we encourage perseverance whether or not it is productive?

How does perseverance develop?

When there is apparent *lack of perseverance*, a child

—gives up a task at the first sign of difficulty.

This behaviour is natural in very young children, but is also found in older children.

Perseverance of an immature kind is apparent when a child

—sticks at a task only as long as there is some external incentive or when he

—sticks to only one method of solving a problem, even when it is not successful.

A more *mature form of perseverance* is apparent when a child

—persists despite difficulties as long as there is a chance of success,
—changes his approach to the problem if his first ideas are not successful.

Do you think all children pass from lack of perseverance to the immature form and then to the mature form? Do some very young children seem to be mature in perseverance? What factors in the child's environment, at home and school, influence his perseverance?

How can perseverance be encouraged?

Seven ways of helping are suggested

- by providing the resources necessary for children to stick at their problems,
- by catering for the individual characteristics of each child,
- by providing activities which engage children's interest,
- by offering the children a framework in which to show perseverance,
- by allowing children the time to persevere,
- by showing that we value perseverance,
- by our own example of patience and perseverance.

What do you consider can be done under each of these seven headings? What other ways of fostering perseverance should be included?

Curiosity, co-operation, responsibility

Discussions of these three attitudes, along the same lines as for Perseverance, form further sections of *Finding Answers*. You may like to study these sections now or at some point in the near future. Many of the ideas and all of the examples have come from teachers in working groups who helped to develop these sections.

Open-mindedness, self-criticism, independence, originality

A framework for discussion of these four attitudes is suggested in *Finding Answers*. Having studied the more detailed sections on the other attitudes you may well have found that there are general ideas which can be applied to these other attitudes, and to any further ones which you think should be included.

The leading questions and the outlines sketched are of the kind which were found useful starting points for the working groups who developed the sections on curiosity, co-operation, responsibility and perseverance. Those teachers who were in the working groups reported that they found it was of considerable benefit to their own thinking to develop ideas from a few guide-lines rather than always being asked to react to the ready-formed notions of others. We have therefore provided outlines only, for these attitudes, so that those who wish can expand and elaborate them in their own way.

Is there a general pattern in development of attitudes?

The formation of attitudes is subject to so many influences, from adults, other children, material and social circumstances, that it is difficult to define a pattern which can be regarded as the course of development. Nevertheless certain common trends will have emerged from the study of the attitudes so far considered and it is worth while trying to identify emerging themes, for it may help in understanding development of other attitudes which have not been mentioned here.

The immature forms of attitudes, normal for younger children but found in older children and even in adults, are characterized by

- control of behaviour being external to the person,
- lack of appreciation of a point of view other than his own, a 'black and white' view of what is 'right' and 'wrong',
- regarding rules as 'sacred' and unchallengeable.

The more mature forms are characterized by

- autonomy, the exercise of free will in deciding one's behaviour,
- the ability to see things from others' points of view,
- judging right and wrong, taking into account intention and motives and not just the results of an action,
- regarding rules as the result of agreement between people involved and subject to change by agreement.

From these themes we can deduce that true co-operation, for example, cannot be expected if children are at the stage where they do not appreciate the position or point of view of others, nor real responsibility if they regard the control of their behaviour as being

external rather than part of themselves.

The video-tape 'Developing Attitudes' provides some concrete examples of children's actions and responses which can be interpreted in terms of different points in development of two attitudes, co-operation and open-mindedness.

Developing Attitudes (video-tape)

For this video-tape seven extracts have been selected from longer recordings of the children's activities.* They show behaviour from which inferences might be drawn about the level of development of the children in co-operation and open-mindedness.

Commentary

In their activities at school children are developing attitudes as well as skills and mental abilities. Like physical skills and mental powers attitudes develop gradually and it is just as surprising for a seven-year-old to show mature responsibility as it would be for him to grasp the concept of evolution.

Attitudes, by definition, determine reactions, responses and behaviours of various kinds. So from looking carefully at their behaviours we can get some idea of the points reached by children in the development of various attitudes.

These extracts show, amongst other things, different stages in development of two of the attitudes which are especially relevant to children's active learning: co-operation and open-mindedness. We begin with co-operation, and with Colin and Stephen who in this sequence show very little willingness to co-operate.

Colin, Stephen and the teacher are in front of a table on which there are piles of pieces of fabric, which the boys have already sorted. Stephen is gathering all the pieces into one pile again.

TEACHER Now see if you can sort those out again . . .

Stephen turns to the dish of buttons which is also on the table and says something indistinct whilst handling them.

TEACHER . . . in a different way.

STEPHEN *(Still giving attention to the buttons—mumbles.)*

TEACHER Leave the buttons and you can sort those in a minute.

Stephen replaces the buttons and both boys begin to move pieces of material around.

* If you are interested in how and where the video recordings were made please see the supplementary material (pages 198 to 200).

TEACHER Can you sort them out a different way? Think of something else.

Teacher goes away and is heard talking to other children. Stephen's attention is taken by something going on elsewhere in the room and meanwhile Colin goes on putting all the pieces on top of each other on one pile.

COLIN . . . sort it out like that—put every colour on top of each other.

Stephen now looks at what Colin is doing and begins to take pieces off his pile and place them differently on the table.

COLIN Look we can put every colour on top of each other, look, every colour . . .

STEPHEN No.

COLIN . . . every colour, yes.

STEPHEN No.

COLIN Yes.

STEPHEN No.

COLIN Yes.

STEPHEN No.

COLIN Yes.

STEPHEN No-o-o-o.

COLIN Yes.

Stephen turns to teacher. He pushes Colin out of the way and takes possession of the pile.

STEPHEN Co . . . Miss! Colin's putting all the colours on wrong!

Commentary

In their behaviour Colin and Stephen showed a typical indication of absence of co-operation—the appeal to adult authority, since they were unable to deal with their differences by discussion and compromise.

Now we see Jacky and Amanda, who are a little more advanced in their ability to settle differences. Their solution is to define the limits of 'yours' and 'mine' so that they do not interfere with each other and can work side by side but separately:

Jacky and Amanda have a large tin full of sand and several empty yoghurt pots on the table. They are seen having some discussion after the teacher leaves them. She has set them the problem of arranging the pots in the order of the amount of sand they hold. Jacky is the first to start filling a pot with sand from the tin. But Amanda picks up another pot and an egg cup to use as a scoop and begins filling a pot from sand spilled on the table.

JACKY You can use this, see, you have to wait...

Amanda continues to fill her pot from sand on the table.

JACKY You have to wait, 'cos we have to try this...

AMANDA (*Ignoring J.*) One.

JACKY ... or else we're cheating.

AMANDA It's all right.

JACKY We can't do it, Amanda.

AMANDA (*Faint*) We can (*taking another egg-cupful from the table*).

JACKY Oh, Amanda I can't do it.

AMANDA Oh can't you?

Jacky stops filling her pot and tips the sand it contains out on to the table.

JACKY All right, you can do it all there.

They begin to make a pile of sand on the table.

AMANDA You do some.

JACKY Oh, Amanda, I can't.

AMANDA You get it from there and I'll get it from here.

JACKY Yea.

Jacky seems satisfied and begins to move the pots around to separate Amanda's from hers.

Commentary

Jacky and Amanda agreed to work independently and there was little co-operation in their activity. The next two children we see share the activity but find it necessary to make an agreement as to who does what in order to avoid dispute over recording guesses and observations about what sinks or floats.

David and June are sitting at a table on which there is a small aquarium filled with water. Near to David there is a box containing various objects. The teacher is with them but soon leaves.

TEACHER (*Just leaving, having discussed with them what they will do with the objects*) All right?

JUNE O.K. (*To David*) You can do the writing.

DAVID No, I don't want to do the writing, 'cos I did the writing for that (*indistinct*) one.

JUNE So?

June has a paper and pencil and waves with the pencil.

DAVID Yes, so!

David goes on looking at the objects in the box and makes no attempt to take the paper and pencil.

- JUNE All right then, I'll write.
 DAVID Right! Do you think this'll float?
 JUNE (*At the same time*) How many articles are there in there?
 DAVID (*He begins to take the things out of the box one at a time counting softly.*) One . . . two . . . three . . . four.
 JUNE Oh, no, I've just thought, I'll write down the guesses and you can write down the answers.
 DAVID O.K. (*David holds up a small metal object.*) . . . it. Guess it will sink.

June begins to write.

- JUNE Sink (*as she writes*).
 DAVID Sink, put—
 JUNE What is it, a coin?
 DAVID Just put—F coin, coin . . .
 JUNE Coin . . . will . . . sink
 DAVID Will sink.

David puts the coin in the water and it sinks.

- DAVID Right.
 JUNE Right. Oh, go on then. (*She passes the pencil and paper over to David.*)
 DAVID O.K. I'll . . .
 JUNE Just tick it.

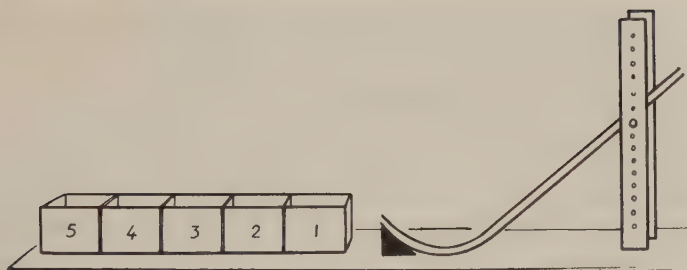
June takes back the paper. But immediately David takes it again.

- DAVID I'll tell you what . . .
 JUNE Now . . .
 DAVID . . . now I'll do the next one. O.K.?
-

Commentary

A more mature level of co-operation is reached when children work with each other, fitting in with the demands of the task and with each others' needs rather than being controlled by rules. Yolanda and Malbindar show this kind of co-operation both at the level of their physical action and in their implicit agreement with each other's suggestions as to how to proceed with the task.

Yolanda is seated at a table on which is this apparatus. Malbindar is standing so that he can roll the balls and retrieve them. They have just completed trials with the track in one position and Malbindar is raising it to another.



YOLANDA Be about eight.

MALBINDAR Seven.

YOLANDA Seven.

Malbindar puts the peg in hole seven.

YOLANDA Put it in.

Malbindar rolls the ball down; it doesn't reach the third box, which is their target.

YOLANDA No. Eight. *(This time she raises the track and places the peg in hole 8.)*

Malbindar then rolls the ball down. It just bounces on the partition between boxes number three and four.

MALBINDAR Four.

YOLANDA I think—do it again though.

Malbindar rolls the ball again with the track in the same position. It again hits the partition and lands in box four.

MALBINDAR Four.

YOLANDA It's hitting that thing *(mumble)*...

Malbindar rolls it again. This time it rebounds into box three.

YOLANDA Yes, again.

Malbindar retrieves and rolls the ball again; it falls in box three but bounces out.

YOLANDA *(laughs)* It went in.

MALBINDAR Yes, that did go in.

YOLANDA Do it again.

Malbindar rolls it once more and it falls into box three.

MALBINDAR Yes.

YOLANDA So, what number is it in? Eight. *(She writes.)* Now, we've got to get it in hole number four.

MALBINDAR Try ten.

He raises the track and rolls a ball down with the peg in hole 10 whilst Yolanda is still writing down the previous result.

MALBINDAR Ten only makes three!

He repeats the run and again the ball falls into box three.

MALBINDAR That's twice ten's made threé.

He does it a third time, with the same result. This time Yolanda is watching.

MALBINDAR We'll have to put it up more.

Yolanda silently agrees and raises the track whilst Malbindar prepares to roll the ball again.

YOLANDA Yea.

Commentary

Open-mindedness is an attitude which is evident when people are prepared to listen to others' points of view, and to take full account of all relevant evidence which is available. If the evidence is convincing, the new ideas are accepted. A lack of open-mindedness shows in a tendency to stick to preconceived ideas despite convincing evidence which conflicts.

In this sequence a group of children, who have been looking through coloured filters and have observed colour changes with different combinations of coloured objects and filters, are asked to say what colour they expect to see when various filters are placed over the coloured numbers in a book.

Six children are grouped round a table, where the teacher is seated. There is a book open on the table and several coloured gelatine filters. The children each have a filter and some are holding it up to their eyes. The teacher picks up the book and points out a coloured number on one of the pages.

TEACHER What colour's the number one on there?

CHILDREN Red . . . yellow . . . yellow.

TEACHER Well, the 'one' is red and the outside, background, is yellow.

CHILDREN (*At the same time*) outside is yellow.

TEACHER Now, thinking of the filter colour that you were using what do you think is going to happen? Before you do it, can you tell me what might happen?

PETER Mine's going to go green.

TEACHER What's going to go? . . . all right—let's do Peter's first.

PETER That's going to go a dark green and that's going to go a light green.

He points to the number and the colour surrounding it.

TEACHER All right, try it, Peter, and tell us if you were right.

Peter bends over the number with the filter to his eye.

TEACHER Put it right over the top and then we can all see it.

Then Peter places the filter flat on the surface of the book.

PETER Yes.

TEACHER What colour is the number one, now?

GARY Black.

PETER Just, just about the darkest green you can get.

TEACHER Just about the darkest green you can get. Well I think Gary thinks it's even darker than that. *(She's laughing and the girl next to her is also smiling.)*

GARY It's black.

TEACHER Gary thinks it's black.

Commentary

In the next sequence both Mark and Andrew show, in different ways, a somewhat immature level of open-mindedness in making guesses as to whether the objects will sink or float.

Mark and Andrew are sitting by the aquarium of water and are in the middle of putting various objects in the water. Andrew is writing whilst Mark is the one who picks up the articles and puts them in the water after they have recorded their prediction of whether each will sink or float.

MARK What's the next one?

Andrew picks up a wooden ball and holds it for both of them to see.

Sink.

ANDREW What is it?

MARK I reckon that will sink.

ANDREW It'll float. What is it? Wooden ball?

MARK Yea.

ANDREW *(writes down the name of the article)* I reckon it'll float.

MARK Float—er—put down float.

Andrew puts it into the water. It floats.

MARK You're right. Well done.

ANDREW Anything wooden should.

Mark takes the ball out of the water.

MARK Anything would(?) But it doesn't (*looking over at the articles in the box*).

ANDREW Do you reckon golf balls float?

Mark picks up a shell from the box. Holds it for Andrew to see.

MARK Float.

Andrew takes the shell and weighs it in his hand.

ANDREW Sink.

Mark seems uncertain; then turns away to the box, picks up something else up, replaces it and then turns back to Andrew.

MARK O.K., put down sink.

Mark puts the shell on the surface of the water, where it stays, floating with open side upwards.

ANDREW Turn it up, turn it up.

Mark flicks over the shell, which then fills with water and sinks.

MARK ... O.K.... sink.

Commentary

Mark was inclined here to be too influenced by Andrew's opinion and seemed to allow it to override his own ideas about the evidence, whilst Andrew was somewhat dogmatic and perhaps took into account only part of the relevant information about each object.

Again it is Yolanda and Malbindar who provide an example of the mature level of this attitude. They explain their own reasoning for expecting a certain pattern of results but are willing to accept that the evidence does not support it.

The teacher is just joining them to find out how they are getting on.

TEACHER Have you come to any conclusions then about what you've been trying to do?

YOLANDA Mm...

TEACHER Are there any differences? According to the size of the ball perhaps?

MALBINDAR The small ones, they seem to get into the holes lower than the big ones do.

TEACHER I see. (*Turning to Yolanda who is consulting her record.*) What number?

YOLANDA Well, (*faintly*) five, seven, eight, fourteen...

- MALBINDAR —and nineteen goes into the biggest hole that—um . . .
- YOLANDA Yea, 'cos we thought that the biggest one would need to go medium I think because it was heavier, and the lighter balls need to go higher 'cos they needed—er—to go down quicker to get anywhere.
- TEACHER Yes, and did you prove that?
- YOLANDA No.
- MALBINDAR But at the moment the big one got into the last hole at nineteen and then (*indistinct*) twenty, and the small one's got into the last hole once.
- TEACHER Oh, I see, so you're still trying to find out . . .
- MALBINDAR Yes, so this is the second time I (*indistinct*) . . .
- TEACHER All right, let's watch that one.
-

Discussion

It is most important to emphasize that judgements of the children's attitudes would not be made on such brief and isolated examples of behaviour as shown here. But since we can't give a full picture of each child, we have to consider these extracts as *examples* of the kind of evidence which we would put together with other evidence to draw inferences about the children's development.

- 1 What other aspects of Colin and Stephen's behaviour besides that pointed out (appeal to the authority of the teacher) indicate their degree of willingness to co-operate?
- 2 Compare Jacky and Amanda's behaviour with the general description of 'immature' and 'mature' forms of attitudes on page 72. It is fairly clear which description fits them. Is the position clear in the case of June and David?
- 3 Yolanda and Malbindar give an impression of peaceful co-operation where there is no need to take turns, etc. But what is the evidence for this conclusion? Try to identify examples of things they do or say which form the basis for inferring their greater maturity?
- 4 Do you find the pattern in the development of open-mindedness as clear as for co-operation? Look for examples of behaviour in the children shown which support inferences about their development of open-mindedness.
- 5 What examples can you give from your own experience which support or deny the proposed pattern in development of co-operation or open-mindedness?

Topic 3: Different ways of thinking

The purposes in this topic are to widen the recognition that there are patterns in children's intellectual development and to attempt to describe different ways of thinking in terms of the stages identified by Piaget.

The development of children's ideas about time provides a good example of how a concept is gradually built up. Several features of the development can be picked out from this example which have relevance when the discussion is later widened to the general pattern of intellectual growth.

Birthdays

TEACHER You're having a birthday after Easter are you? How old will you be then?

JACK Six.

TEACHER How many birthdays have you had already?

JACK About four.

TEACHER What happens on a birthday?

JACK Everybody...my friends come, and...I get some presents and some Christmas trees, and my Christmas tree can have some lights.

TEACHER But birthdays are different from Christmas, aren't they?

JACK Yes, I sometimes have my birthday at home and sometimes at school.

TEACHER How often do you have them?

JACK After Easter...or...after George's birthday.

TEACHER Who decides when you're going to have a birthday, then?

JACK Mummy. Mummy knows when I'm having a birthday.

TEACHER How old are you Julian?

JULIAN Four.

TEACHER Are you going to have a birthday soon?

JULIAN (*nods*)

TEACHER Are you? When are you going to have it?

JULIAN I don't know.

TEACHER How old will you be when you have it?

JULIAN Five.

TEACHER How many birthdays have you had so far?

JULIAN One...no, I've had two.

TEACHER If you'd only had two birthdays you'd only be two years old. You're not only two years old are you? How old are you?

JULIAN Four.

TEACHER So how many birthdays have you had?

JULIAN Two.

TEACHER How many years have you been living?

JULIAN Fifty.

ANGELA It's John's birthday today. He's eight like me, but I'm older than him because I'll be nine next month.

TEACHER Does it take you a whole year to get older?

ANGELA Yes... no, it doesn't.

TEACHER Are you any older today than you were yesterday?

ANGELA No—I was eight yesterday and I'm eight today.

TEACHER So now that John is eight is he exactly the same age as you?

ANGELA Yes.

TEACHER If I have something to give to the one who is older who would get it?

ANGELA John.

TEACHER Why?

ANGELA No, I think it would be me, because I was eight... if he had caught up with me I would have been it before him and he would only just have caught up.

TEACHER Catching up—would that not make you the same age?

ANGELA No, I don't think so. I'm older, because I'm eight and a half.

TEACHER Are you getting older now—tomorrow will you not be older than you are today?

ANGELA No. I'll be the same until April the 28th.

TEACHER What does getting older mean?

ANGELA If I'm eight and I have my birthday today and become nine it means that... um... getting older means that when you have a birthday you get older and older each year. I'm not quite sure what old means... it means you get grey hair and wrinkles—I think so. It's a pattern, there's a pattern because you get smaller and then taller and then taller and then you get—big.

TEACHER Do you carry on growing taller as you get older?

ANGELA Yes, you do.

TEACHER Always?

ANGELA Sometimes you do and sometimes you don't. Because when I was a little baby I was very small and now I'm quite tall.

TEACHER What about grown ups? Do they go on having birthdays?

ANGELA Yes, they do.

TEACHER Do they continue getting taller?

ANGELA No. I don't think they do. I'm not quite sure. I think some people do, but some people don't. When you're old you can also grow smaller.

TEACHER Do you know anyone who's grown smaller?

ANGELA No, but I know people who've grown bigger. My uncle's

- grown huge!
- TEACHER Has he stopped growing yet?
- ANGELA No, he's still carrying on growing.
- TEACHER Is he old?
- ANGELA He's in his thirties.
- TEACHER How old is old? What would you think is old?
- PETER About a hundred.
- ANGELA No. It depends on the person. If it's a weak person it doesn't take very long—if it's strong and lively it's quite long.

Time, speed and distance

On another occasion Angela and her teacher are looking at a large clock and the teacher's watch.

- TEACHER Are they both at the same time?
- ANGELA Yes.
- TEACHER How long does it take that finger (*the large one*) on the watch to go right round and back to where it is now?
- ANGELA Um... (*long pause*) half an hour, I'd say.
- TEACHER Half an hour?
- ANGELA Quarter of an hour?
- TEACHER That large finger?
- ANGELA An hour.
- TEACHER How long for the large finger here (*on the clock*) to go right round?
- ANGELA An hour. They'll both be the same, because they're both at the same time and they'll both be going at the same speed. So they'll have... that clock won't have a longer hour than that one... because they'll both have the same amount of speed going to the twelve, all the way round.
- TEACHER Which is the biggest space, between number 4 and number 5 on the big clock or between number 4 and number 5 on the watch?
- ANGELA The big clock, because it's got a bigger face and bigger numbers... and your watch is a small watch and it's got—about a centimetre and this has got about two centimetres.
- TEACHER Which one will take longer, to move from four to five on the big face or from four to five on the little face.
- ANGELA They'll both have the same time—ten minutes.
- TEACHER Does it take ten minutes?
- ANGELA No it wouldn't. I don't know why... it might take...
- TEACHER When it's on the four what is the time?
- ANGELA Twenty past—twenty minutes past.
- TEACHER And when it's on the five?

- ANGELA Twenty-five minutes past.
TEACHER How many are there between twenty and twenty-five?
ANGELA Five minutes—Oh!
TEACHER Didn't you realise that before?
ANGELA No.
TEACHER When it's on the six what time is it?
ANGELA Half past.
TEACHER And how many minutes are there in half an hour?
ANGELA Six.
TEACHER Are there? How many minutes in one hour?
ANGELA Twelve.

Some time is spent sorting out Angela's confusion between the number on the clock face and the time in minutes. She realizes that the time between four and five is five minutes.

- TEACHER Is it the same on both the clock and watch?
ANGELA Yes, the hand moves from four to five at the same speed as each other.
TEACHER It takes the same time, but are the two hands moving at the same speed? Remember you said it's about twice as far from four to five on the clock as it is on the watch.
ANGELA Yes, it's the same speed and the same time—it must be.

Pauline (who is also eight) was asked the same kind of questions when she asked to look at the teacher's watch because she thought her own was slow.

- PAULINE Yours says ten to, mine's not quite on the ten.
TEACHER How many minutes will it take for the big hand to move to number eleven?
PAULINE Five on yours, but a bit more for mine 'cos it's slow.
TEACHER What does 'slow' mean?
PAULINE Well, it's—um—got a bit less time.
TEACHER Does that mean the time is really less?
PAULINE No—it's really ten to—if yours is right—but mine isn't going round so quickly so it hasn't got so far.
TEACHER Let's look at the big clock. Is the distance from ten to eleven the same as it is on my watch?
PAULINE What do you mean in . . . er . . . time?
TEACHER I meant in the actual distance the end of the hand moves.
PAULINE Well, that's bigger on the clock, but in time it's the same.
TEACHER So is the end of the hand on the clock moving at the same speed as the hand on my watch?
PAULINE No. The one on the clock is moving faster 'cos it's got a bigger distance to move round.
TEACHER Is it still the same time it takes then?

PAULINE Yes.

TEACHER So, what's wrong with your watch going more slowly than mine then?

PAULINE Yes, but yours should go more slowly than the clock but mine shouldn't go more slowly than yours.

Heart beats

Julia (8) and Sarah (10) have timed the heart beat of other children before and after exercise after they had noticed that their own hearts seemed to beat faster when they had been running. They are discussing the results with the teacher and with the six-year-olds who were their subjects.

SARAH Andrew's was 21 times in ten seconds after he had been running. Emma's was 25 times in ten seconds.

TEACHER Whose heart beat was measured for the longest time then?

ANDREW Emma.

TEACHER What does Emma think?

ANDREW Emma.

JULIA Andrew.

SARAH It was the same time—they both had ten seconds.

JULIA Andrew, because he's got 25 and Emma's got... oh, wrong... no it's Emma.

ANDREW Yes, because Emma's was beating faster.

JANE Yes, yes, Emma.

TEACHER Why do you think that?

JANE Well, Emma's was beating faster and she did take the longest.

TEACHER So you don't think it was beating for the same time?

JANE No.

Later Julia and Sarah have recorded their results putting blue and red lines for each person to represent by their length the number of beats in ten seconds.

TEACHER What are the red ones standing for?

SARAH The red ones are standing for the heart beat after they had been doing some exercise, and the blue stands for the beginning...

JULIA ... their normal heart beat.

TEACHER What do the red ones tell you then?

JULIA It tells you how many beats in ten seconds.

TEACHER All the red lines are longer than the blue, aren't they?

JULIA Yes, that's because they all went up after running for a minute.

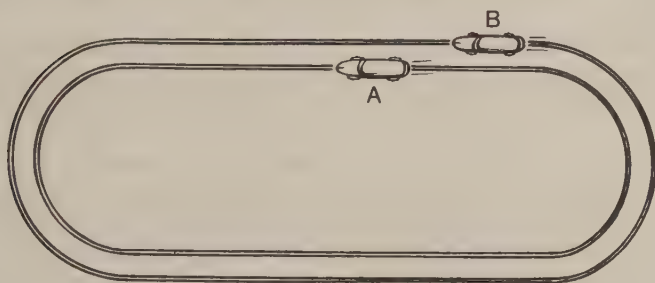
TEACHER Looking at these two, does the red line stand for a longer time than the blue one?

JULIA Yes, because the blue one's shorter and the red one's longer.

TEACHER What do you think about that, Sarah?

SARAH They were both measured for the same time, it's just that the red one's beating faster because they've had exercise.

Mark (11 years) brought his electric car track to school on a special occasion. He set it up in this shape:



Whenever the cars were raced flat out the one on the inner track invariably came off the track. He reported this in discussion with the teacher about the speed of the cars.

MARK The problem is that you can only really use the outer track because the cars can't get round the bends.

TEACHER Yes, I see. Well let's just imagine that they would stay on, and you had two cars starting together on the line and going all the way round and finishing together, would they go round as fast as each other?

MARK No, they wouldn't because there's a gap between this track and this one, and all the way round, when you go to a bend, every bend he (*indicating the car on the outer track*) has to go slightly further than the other car. You see this in a real race, one starts behind the other to make up for the difference on the bend, except where you can go on any side any way.

TEACHER (*places a car at A and one at B*) Suppose these started like this and went round and ended together, which would have won?

MARK Well it depends really, it depends if that gap (*between the cars*) is equal to the distance that one has to make up to come level with it.

TEACHER With only one track you can find out which one goes fastest?

- MARK We can time them.
- TEACHER Does that tell you how fast they go?
- MARK If we measure the distance round the track—say it's six feet and it takes twenty seconds, then that's...er...60 seconds in a minute, so eighteen feet in a minute, and sixty times that again in an hour.
- TEACHER Would that be the speed it had all the time, right from when it started?
- MARK Yes, you can't make an electric motor go faster.
- TEACHER But it starts from still, not moving, doesn't it?
- MARK Yes, but it gets up to top speed almost straight away.

The fact that children have some 'strange' ideas about time is nothing new—especially to the teacher (or mother) who has been asked if she wore a crinoline when young! But what signs of development can we see?

For Jack and Julian it seems that events which mark the passage of time are not recognized as such. From other evidence, too lengthy to present here, it is possible to infer that for them

- the time of day is tied to events ('morning' is before dinner),
- time intervals are judged from what happens to each of them,
- the idea of 'universal' time, the same for everyone, is quite absent, they have their own local time.

In the case of Angela we can infer that she links birthdays with years of life but she is unsure of what happens in the time between birthdays. Also

- she seems to realize that time goes on for everyone,
- she can read a clock dial, but not really grasp the meaning of the time intervals it measures,
- she is unable to distinguish speed and time.

For Sarah and Pauline it seems that a time interval is more clearly distinguished from the events which take place in the time. From other evidence it is inferred that these girls

- have a good idea of the time intervals measured by a clock, appreciate time as continuous and the same everywhere despite the time of day being different throughout the world,
- realize that both distance and time of travel have to be taken into account in comparing speeds but are not able to manipulate these quantitatively.

Mark has very clear ideas about the relation of speed, distance and time and can calculate average speed. The notion of change in speed still presents him with difficulties.

On page 109 of *Finding Answers* there is a summary of characteristics of children's thinking about Time at different points in development. The points made there are illustrated by many more examples in the rest of the chapter on Time.

Possible patterns

Time as local, personal	→	Time as continuous, same for everyone
Time linked to what the individual does	→	Time independent of an individual activity
Time ignored in comparing the rates at which things take place	→	Time taken into account in comparing rates
Speed judged from distance travelled only	→	Speed judged from time and distance

A general pattern?

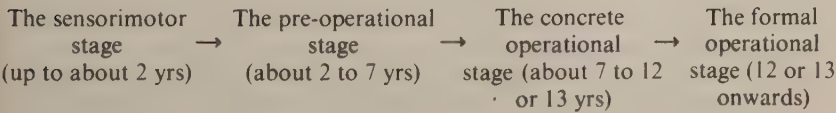
A pattern which links all aspects of the concept time can be proposed in terms of a development:

from: -----	to:
ideas based on a one-sided personal view of things; reasoning takes account of only one aspect of a situation.	ideas based on considering others' points of view; reasoning which considers several aspects and can deal with the relationship between a number of variables.

The study of children's thinking in other areas besides that concerned with 'time' has shown that this pattern, somewhat oversimplified here, describes development of many different ideas and concepts. Therefore by looking at the general pattern in more detail we can cover a much wider range than if we consider each concept separately. Much of the work of deciphering the general pattern has been done by, or inspired by, Piaget, and for this reason we now look at the results of his work.

The stages in development described by Piaget

Development is continuous; it does not take place in jumps from one point to the next. However in describing a continuous process it has to be broken into sections, which can be chosen arbitrarily or for reasons which are suggested by the process. In defining various stages or sections of development Piaget selected periods where the characteristics of thinking in these periods were distinct from other periods. He found four main stages:



Note that:

- (a) the ages given are the broadest indications only, and wide variations are found in all cases, but particularly for the transition from the concrete to formal operational stages;
- (b) the important characteristic of stages is not the age at which they appear but their order. Piaget states that this succession of stages is the same for all children, but the rate of movement from one stage to the next varies between individuals;
- (c) each stage builds upon the one before and is a basis for the succeeding one, so previously acquired ideas persist and each stage is defined in terms the best a child can do at that point.

We leave the discussion of ideas about how thinking changes and what influences the rate of development until the three stages most relevant to children from five to thirteen have been examined. Characteristics of these three stages are outlined in the Supplementary Material on the following pages:

The pre-operational stage.....pages 213 to 215

The concrete operational stage.....pages 215 to 218

Towards formal operational thinking.....pages 218 to 230

Discussion points

The pre-operational stage:

- 1 The development of verbal ability marks the beginning of this stage but Piaget does *not* equate language with thinking. He considers that children develop their own ways of representing objects and events which are the subject of thought. Language provides symbols which are shared by others and facilitate communication. Words add to the representations, but thought is not only in terms of words. On the other hand there are those who consider that the thought *is* the word.

Does your experience of children suggest that children think about things before they are able to express the thoughts in words?

- 2 Some of the limitations of the pre-operational stage of thinking have been outlined. Does your experience support Piaget's idea that children in the age range 2 to $6\frac{1}{2}$ or 7 are limited in their mental abilities in the respects suggested?
- 3 Take one or two examples of how a child in an infants' class has approached a problem, and commented on things around him, or of the questions which have been asked and consider to what extent the behaviour is described by Piaget's account of pre-operational thinking.

The concrete operational stage:

- 1 One suggestion here is that the qualities of thinking in this stage

- have repercussions in children's social interactions and communication as well as in concepts about physical quantities. Do you find this pattern in your observations of children—e.g. is there a tendency for the ability to see others' points of view to develop at the same time as ideas about conservation of physical quantities?
- 2 Does Piaget's claim that for most children from 7 to 12 or so thinking is restricted to the concrete, as defined here, make sense in terms of your experience?
 - 3 Consider some examples, collected from the group, of things done by junior children and consider how well the level of thinking carried out by the children is described by Piaget's notion of concrete operational thinking.
 - 4 Do you think children who are capable of concrete operational thinking also behave on occasions as if they were still at the pre-operational stage? If so give an example which illustrates this happening.

Towards formal operational thinking:

- 1 The following is the kind of problem which if solved in the head only requires formal operational thinking:
 John ran faster than Jim and John was slower than Peter.
 Who ran the slowest?
 If the three boys were seen running there would be no problem, so the difficulty lies in the form of presentation in this case. Can you give examples of children not being able to tackle a problem in one form but finding less difficulty when it is put differently?
- 2 Does your experience of pupils whose thinking seems to be developing towards formal thinking suggest that the intellectual changes are accompanied by changes in attitudes and personal qualities, such as confidence and responsibility?
- 3 Do you think the importance of first-hand concrete experience diminishes when formal thinking begins to emerge?

Summary of development and appropriate activities

The detailed study of development is worth while because if we can recognize where a child has reached we are more likely to be able to help him. Some activities and approaches are an aid to progress at some stages but not at others. The subject of providing appropriate experiences is taken up in greater depth in Theme C: 'Making Decisions about the Learning Environment', and in *Finding Answers*. However, it may be useful to have, in very general terms, an idea of suitable kinds of activities at the three stages we have considered along with a summary of the main points about each stage.

Summary of characteristics of stages*Pre-operational thinking*

Child has a one-sided view of the world. Everything is centred on himself, he cannot see things from any point of view but his own.

He has to *do* things in order to find out what happens—he cannot think out likely consequences (unless it is something he has done before).

He tends to see one aspect or variable at a time and ignore others.

When things are made to *look* different they *are* different to him even if there is no real change.

Appropriate activities

Being able to *act* on things, to touch, manipulate and carry out physically the actions they are unable to carry out mentally. Experience of trying things out to see the result for themselves and of exploration which enables them to link cause and effect. Repeating an activity several times over if desired.

Concrete operational thinking

At first: He begins to bring together the parts of a process and to think out what might happen as the result of an action or change. He may notice more than one variable but his ability to see the effect of changing and combining variables is still very limited. Problem solving is still unsystematic, 'trial and error', and the tests he uses very often unfair. Later: A greater ability to manipulate things mentally, to plan ahead and to approach problems systematically; an increasing need for and use of measurement and recording.

Thinking limited to concrete things (i.e. with a reality for the child), ability to deal with variables incomplete except in simple cases.

Exploring a wide range of problems in real situations, and through books, and coming gradually to see patterns, not being forced to generalize or draw conclusions. Planning and carrying out investigations or methods of problem solving which they have devised, discussing results and learning from mistakes about the variables which should be controlled. Putting problems in concrete terms where doing can support thinking.

Formal operational thinking

Child has a growing ability to see individual problems in a wider context, as related to other problems and capable of being generalized. He makes use of abstract notions in explaining cause and effect and can think in terms of the hypothetical and the possible as well as the actual. He recognizes all the variables relevant in a situation and can control them when testing out the effect of changes.

Sometimes, but not always, drawing conclusions from previous learning and applying principles to new problems. Finding out by planning experiments which control all necessary variables. Abstracting ideas about properties of materials. Devising and using theoretical models for explanations and predictions.

Topic 4: Development in thinking

The purposes in this topic are to try to identify evidence in children's behaviour which indicates where they have reached in developing their thinking, and to discuss factors which influence the development.

Video-tape recording on 'Levels of Thinking'

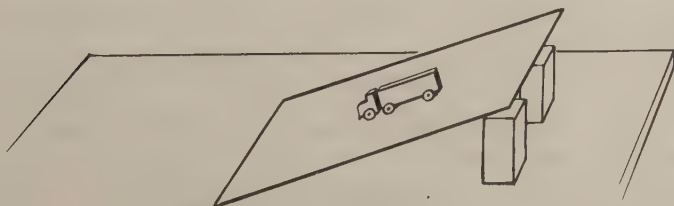
The extracts shown in this video-tape have been chosen because they show examples of children's behaviour which seem to give evidence of different kinds of thinking. We cannot show any long sequences; therefore we see only some of the behaviours which can indicate one or other of Piaget's stages. In practice it would be unwise to base inferences on the slight evidence which is shown, though observations of the children over a much longer period did substantiate the inferences made about their thinking in the commentary.

Levels of thinking (video-tape)

Commentary

In describing development in children's thinking we have found it helpful to speak in terms of the stages identified by Piaget, which label periods where thinking has well defined characteristics and which help us to see the patterns of change as children gradually learn to make sense of the world around them.

The first stage which we meet in children of school age is described by Piaget as the pre-operational stage. At this stage a child generally has to *do* things in order to find out what happens, unless it is a routine with which he is familiar. We see this kind of thinking in Neil and Simon who are enjoying rolling model trucks down a slope but have ignored the possibilities of investigating systematically the effect of changing any of the possible variables. After raising the slope they find the trucks run off the end of the table, so the teacher asks them what they can do about this.

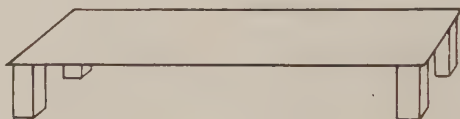


- TEACHER Now is there anything we can do with the ramp to make them stop before they get to the end?
- SIMON Um, yes...
- NEIL I know, make it real high.
- TEACHER Make it really high? Will that stop them before they get to the end?
- NEIL Yea.
- SIMON No, that'll make...

They begin to prop up the lower end of the ramp using wooden bricks and stones.

- SIMON (*mumbling*) That 'un. (*They laugh.*) I think that would. Now we need another under this end (*Going to the end that was higher.*)

The ramp is now supported like this:



- SIMON If you whizzed 'em... down there! I expect...
- TEACHER Are they going to be able to run down there?
- NEIL No, they're not.
- SIMON No, but they fall off, look.

He puts a lorry on the board, is about to push it, but doesn't. It stays put because the board is horizontal.

- NEIL Yea...
- TEACHER But I don't think we want them to fall off. We want to see if we can get them to stop before they get to the end of the table.

The boys adjust the height of one end of the ramp, lowering it so that the lorry placed on the end rolls along and falls off.

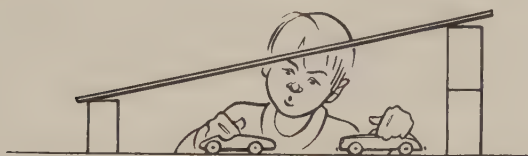
- SIMON Put another one underneath this; let's have one of those.
- NEIL Got it.
- SIMON (*Mumbling and turning away*) You sort that out.

He goes to the higher end of the board leaving Neil to arrange a lower support for the other end.

- SIMON I'm playing with these little dinkies.

He takes some cars and begins to play on the table beneath the board.

SIMON Meemeemeem . . . (*engine noise*)
You play with the dinky ones. I'll play with the dinky ones, you play with the big ones.



SIMON I'm playing under the table. I need some bricks, please. Bricks please . . .

Commentary

Neil and Simon didn't seem able to envisage what would be the result of raising the lower end of the slope—they had to do it to find out; for them action cannot be replaced by thought.

The ability to think through an action rather than carry it out appears at the next stage, described as concrete operational. But the actions which can be thought through in this stage are limited to things which are real, not abstract, and the ability to handle variables is limited. Thinking still lacks the wider framework in which a whole range of possibilities can be entertained, and with this limitation problem solving may be rather unsystematic and a matter of trial and error rather than the logical elimination of possibilities. This aspect of concrete operational thinking is shown here by June and David, who have the problem of distinguishing between three eggs, one hard-boiled, one soft-boiled and one raw, without breaking the eggs.

June is placing the eggs in a jar of water. She stops to pass a paper and pencil to David who begins to write.

DAVID A . . . B . . . C . . . (*as he writes*).

June places the last egg in the water.

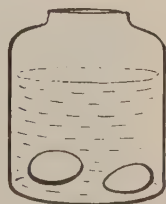
DAVID They all sink!

JUNE Mm.

DAVID Yea, but look, this one's . . . —that one's—larger. (*They laugh*).

JUNE Now what do we do?

DAVID Take them out again, s'obvious.



He puts his hand in the water and begins to take them out. One seems to float around more than the others as he touches it in the water.

DAVID Look at that one, this one, look, June.

JUNE That one's the one that's not boiled.

DAVID How do you know?

JUNE Oh, I'm not stupid.

DAVID Shall I put them in there, or in there? (*On the table or in the container where they were first.*)

JUNE Yea, put them in there.

David puts the one he took out in the container and June brings out the other two eggs.

JUNE There's B... (*as she passes them to David who places them carefully.*) Now put them in salty water. Put them in salty water.

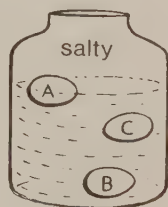
David picks up A and puts it in the jar of salty water.

DAVID A Floats. A.

JUNE B (*She puts B in. It sinks.*)
Sinks.

DAVID C.

He puts it in the salty water. It goes to the bottom and slowly begins to rise again.



JUNE Sinks.

DAVID Yea look... no, it doesn't.

JUNE No... that one (*she points to C. Pauses, uncertain for a moment*). No, how are we going to tell...

DAVID That one's...

JUNE Hard-boiled. The one at the bottom's hard-boiled. Put C hard-boiled. (*She instructs David to write. But it isn't C which is at the bottom!*)

Commentary

Notice how June in particular jumped to conclusions about which egg was hard-boiled without any logical argument to relate her judgement to the evidence.

Another feature of concrete operational thinking is the limited range of possibilities which are considered at any one time. This is evident here where Jane and Aidan are using an apparatus in which ball-bearings run down a track and take off to land in one of the five boxes. They are finding out which positions of the track send the balls into each of the boxes, and whether the answer is affected by the size of the ball-bearings.



JANE Aidan, maybe we can get into number one with this one.
(She rolls a small ball-bearing down the slope, starting right at the end.) Yes!

Aidan picks it out of box number one. Jane is moving the peg up one hole.

AIDAN Move up about . . . what number is it on? Four?

JANE Yea.

AIDAN Well it should be, it should be in that one on eight, shouldn't it? *(He reaches over to put the peg in hole 8 instead.)*

JANE No!

AIDAN Yea, try eight, I'll bet it . . . it'll go in.

Aidan leans across Jane to roll a small ball down, but it jumps off the track and is chased by Jane.

JANE Now it's my go. There it is.

AIDAN Try it on eight. 'Cos if that took four to go up there . . .

JANE Yea

AIDAN Well it should, er . . .

Jane rolls the ball down with the peg in hole 8.

BOTH Yes!

JANE Shall I put it on twelve?

AIDAN Should go in three. *(He means into box number three.)*

He rolls the ball. It goes into the third box.

BOTH Yea!

AIDAN Sixteen *(as he recovers the ball from the box).*

JANE What's that, twelve? *(Writing the result down on paper.)*

Jane moves the peg to hole sixteen.

AIDAN Sixteen.

JANE My go.

AIDAN It must be.

JANE This'll make it. *(She rolls the ball. It reaches the fourth box.)*
 Yes!

Commentary

They attack the problem systematically keeping to one size of ball until it has been in all the boxes, and Aidan in particular is thinking ahead and using a pattern to decide which holes to try; from these things it is clear that they are operational thinkers. But neither of them attempts to repeat observations, nor to find out if a ball can reach a particular box from a range of positions on the track. In their discussions with the teacher it is clear that the lack of checking is not an oversight, but it just did not occur to them that a single result is just one of several possibilities and may not be repeatable.

JANE (to teacher) Finished!

TEACHER (coming to join them) All right. What have you found then?

JANE (pointing to the results she has put on paper) Well it starts off at four. Well that's going up in fours up to there, and we still get six fours. We just missed out one from there.

TEACHER Yes, I see.

JANE Then you've got, they both comes to twenty-four, the medium and the small, to get it into number five (*i.e. into box number five*) and that one's five, add two's seven, add three's ten, then that's four, add four, that's fourteen ... six, seven, eight, nine and ten, and that's ten. So and then that one goes up in ...

Aidan is leaning across to follow what is written.

AIDAN }
JANE } twos, then threes, then fours, then tens.

TEACHER I see, and what about the larger one?

JANE That one goes up in twos, up to seven.

AIDAN Yes, that's three.

JANE ... and that's five. Then it goes from twelve, that goes eight, nine, ten, eleven, then it goes on up to the end.

TEACHER I see. How many times did you try rolling the balls?

JANE What d'you mean?

TEACHER To check the results. Have you checked them?

JANE No.

TEACHER Or did you just—you rolled them once did you?

JANE Yea.

AIDAN Yea.

TEACHER Then how about checking them, then, just to see if you were right?

Jane immediately begins to prepare for repeating the runs at the same positions as before.

JANE The first one's number four ...

Commentary

With this same apparatus and problem Yolanda and Malbindar quite spontaneously check each run and also explore the range of conditions which might give the same result.

MALBINDAR Let's see how far it will go from one. (*He puts the peg in hole one.*)

YOLANDA No, it won't go very far, look.

Malbindar rolls a ball down. It falls short of the first box.

YOLANDA No. (*as Malbindar begins to raise the track*) About . . . er . . . five.

MALBINDAR Number five.

He puts the peg in the fifth hole and Yolanda rolls a ball. It lands in the second box.

MALBINDAR No. Too far . . . try four.

YOLANDA Three.

Malbindar moves the peg to three. Yolanda rolls the ball. It lands in the first box.

YOLANDA That's number one, so number three . . . (*goes to start writing down the result*).

MALBINDAR Try two, 'cos two might make it into one.

YOLANDA That was in number one.

MALBINDAR No, try two in it.

YOLANDA What, get it up on two?

MALBINDAR Yea.

Malbindar moves the peg to hole one. Yolanda rolls the ball, which falls short of the first box.

YOLANDA No.

MALBINDAR No. So two . . . is two. (*Writes down the result.*)

YOLANDA Two's the lowest you can get.

While Yolanda writes, Malbindar lifts the track high. It seems that he wants to explore the range of positions first and see from where the ball will reach the fifth box.

MALBINDAR Try five now. Which number goes up to five?

YOLANDA No, we've got to get number two now.

MALBINDAR Er?

YOLANDA We've got to get number two.

MALBINDAR All right, hang on then, try . . . (*He lowers the slope again.*)

YOLANDA Eight, I think.

MALBINDAR Try four.

YOLANDA All right, try five, four. Biggest one.

ALLYSON So, therefore it'll come up quicker.

DEIDRE Yes, but it's not bad.

TEACHER What'll it be like inside?

ALLYSON Runny.

TEACHER It'll be runny still, I see.

What influences mental development?

It is important to know the powers and limitations of children's thinking at various points in development and to be able to recognize where a child has reached. To help a child's learning, however, we have to go further, to consider the factors which influence development. In doing so we find that some factors are related to past experience and circumstances beyond the influence of a teacher, but other factors are subject to decisions made in the classroom. The way in which the various factors combine to bring about development in thinking provides a major argument in favour of 'matching'.

Transcript of audio-tape

Having looked at the characteristics of children's thinking at different points in their development the next thing to consider is the process of change from one stage to another. It must be remembered that the 'stages' are convenient labels for parts of a continuous process and Piaget's findings have provided a useful way of describing them. We again find that Piaget has given us an important lead as we face the questions:

What causes children to change their way of thinking?

What is it that activates development from one point to another?

How can we help this development, both within and outside school?

These are complex questions and we can't expect easy answers.

Let's begin with the first question—why does a child change from one way of thinking to another, say from pre-operational to concrete operational thinking? There are four factors to consider and we shall see that each is important but insufficient on its own to account for development.

The first is growth, the process of maturing physically. It includes growth in size and development in various qualities, i.e. the body becomes not only bigger but also stronger. The brain and nervous system also mature, though not much is so far known about the kinds of changes which take place after the first few years. What we do know is that growth and maturity which depend largely on the passage of time are important factors—the same

child can learn many things at five that he can't at two—but on the other hand these are not enough to account for mental development. Children of the same age and physical maturity can differ widely in mental development, so evidently other factors are important.

One of these is experience, the second of the four factors. Experience can be of two kinds: of direct contact with objects, through touching, handling and using other senses to get to know about the object; and the other is experience of carrying out actions on objects, which tells you something about the results of various actions, such as, that the total number of sweets you have is the same when they are in one bag, spread out in a line, divided into two bags or hidden away. The actions tell you not about sweets in this case but about how number is conserved—providing nothing is taken away, that is!

Again it is not difficult to agree that experience of both objects and actions must have some influence upon mental development, for we don't develop ideas unless the ideas are related to something. But experience also is not enough. Think how much experience a child has of conservation, for example, in various situations at home before he reaches school age. He probably plays with water, pouring from one container to another, he gets into water in the bath, displacing some and causing the level to rise, but not for several years after he reaches school will he develop the ideas about volume which are evident in these experiences. In the home there is plenty of opportunity to see one-to-one correspondence and number conservation—the cups and saucers on the table may start off in two piles, be matched up, grouped together and then distributed—yet children of six or seven can still think that the number of objects is changed if their arrangement is altered to make them look different.

The third factor is social interaction, at home, school and elsewhere. Usually the most important channel of social communication is through language, but just because children hear or read something this does not mean that they understand it. We can tell a six-year-old about the theory of relativity if we want to but he won't be able to make sense of it because he has not developed the ways of looking at things, the logical ideas, which would enable him to take in the information. Thus again we can say that this factor is important but does not account for much on its own.

The fourth factor is one of the child's active response which regulates the effect of the other three factors. The physical growth, experience and social communication may all have some impact on mental development if there is a response to them in which the child's ideas are to some extent changed. When new experience

does not fit in with his existing ideas then, if circumstances are right, he may change or 'accommodate' his ideas to fit the new experience, and in doing so he gradually develops from one way of thinking to another. To give an example of a situation in which this might happen, consider the real case of a seven-year-old boy who, for medical reasons, had to eat a special diet and so took sandwiches to school. His diet allowed him four sandwiches, but he began to ask for more, which his mother knew would not be good for him. So she cut the four sandwiches in half: for a while he was quite happy that he had more. After all, eight *is* more than four—or so his experience had taught him! Of course it didn't last for long, and while we don't know exactly how he came to realize that there was no difference, it seems quite likely that on occasions he put the eight sandwiches together to look like four and separated them, and put them together again. Gradually his initial idea that eight sandwiches were necessarily more to eat than four came to contradict the evidence that in this case they were exactly the same! Perhaps this contributed with other experiences to changing his way of looking at situations of this kind.

Perhaps we are now some way towards the second question posed at the beginning—what is it that activates development from one point to another? It seems that we can describe it as the child's response to certain experiences, at first hand or transmitted by others, which causes him to accommodate his existing ways of thinking to make sense of the new experiences. At any one time the child's way of looking at things enables him to make sense of some things but not of others—a nine-year-old can work out how to light a bulb from a battery, but probably not explain the working of the battery. In accommodating his ways of thinking to new experience the change he makes is generally a slight adjustment, and thus to help the development new experiences should keep pace with and not be too far ahead of his existing ideas. If the gap between his present ideas and new experiences is too great, on the other hand, the experience cannot be taken in and no accommodation or change in response to it takes place.

Thus providing there are experiences which a child can take in with his already formed ideas, then challenge to these ideas from experiences which do not entirely fit them is a good way to encourage progress. The child then proceeds by small degrees, from one level to a slightly more powerful way of thinking, but he cannot jump several levels at a time.

If the gap between a child's way of thinking and that which is needed to take in an experience is too great he fails to learn, if by learning we mean the development of new ways of thinking and ideas. He may fall back on rote memorization if he feels the pressures to appear to succeed are very great. But *he* knows he

has failed to understand and if this failure accumulates he may well develop, instead of higher mental abilities, a feeling of dislike for this kind of activity, which may be reflected in other areas of his school life. The other side of the old adage about success breeding success is that failure brings failure. In the years when children's learning and mental development are so closely interwoven we should avoid repeated failure at all costs for it affects not just present learning but future mental development as well.

So, finally, are we able to find any clues to our third question: how can we help children's mental development? The main point which emerges is that experiences and social communication which we provide for children should be at a level and in a form which they can take in. In other words we should try to 'match' the learning opportunities to a child's level of development and make them available to him in a way which will engage his interest and attention. But the situation is rather more complex, for we should remember that children differ from one another in many more respects than in level of intellectual development, and 'matching' means adapting activities to suit individuals as far as possible in as many ways as possible. In fact 'activities' is the wrong word here, since we are speaking of the activities and all that surrounds them; it is better to speak of the 'learning environment', the whole situation in which children learn, since such things as the atmosphere of friendliness or fear, the freedom of choice, the encouragement or neglect, will affect mental development as well as the level of thinking demanded by an activity. Approaches to adapting the learning environment to provide the best opportunity for children to progress in this development are the focus of attention for the rest of this theme.

Points for discussion

- 1 'Learning' has been regarded here almost as if it is the same thing as mental development. On the other hand many people think of 'learning' as 'rote learning'—for example saying 'six sevens are forty-two' over and over until it is almost an automatic reaction to say 'forty-two' whenever someone says 'What are six sevens?' The argument here has been that this rote learning is not lasting unless it fits into a pattern of existing ideas and helps in the process of making sense of experience. (After all one could equally well 'learn' that 'six sevens are forty-five' by rote, but this would not make sense in terms of experience or fit in with one's ideas of numbers and the meaning of multiplication.) Do you think all learning should fit into this pattern of gradually making sense of things, or is there an important part for rote learning to play?

- 2 The distinction between the two kinds of experience—of things and of actions upon things—has very important implications in practice. It is illustrated further by this example recounted by Piaget about a friend's recollection of an early experience which had a considerable impact on him as a child:

When he was four or five years old—I don't know exactly how old, but a small child—he was seated on the ground in his garden and he was counting pebbles. Now to count these pebbles he put them in a row and he counted them one, two, three, up to ten. Then he finished counting them and started to count them in the other direction. He began by the end and once again he found ten. He found this marvellous that there were ten in one direction and ten in the other direction. So he put them in a circle and counted them that way and found ten once again. Then he counted them in the other direction and found ten once more. So he put them in some other arrangement and kept counting them and kept finding ten. There was the discovery that he made.

Piaget (1964)*

Do we give children enough time and opportunity for experiences not only of things but of actions on things in the junior and middle years as well as in the infants' school?

- 3 The example given of the boy with his sandwiches is the kind of situation in which you can almost see 'the penny drop'. Can you think of other instances when children have quite suddenly seen that things were not as they first thought? Does the notion of 'accommodation' of thinking make sense in explaining the changes in the children's ideas?

Topic 5: Matching in theory

The purposes in this topic are to bring together the reasons for matching and to discuss what is involved in attempting to bring it about.

Some teachers seem to be able to match intuitively, almost as an automatic response, especially in terms of the personal approach to a child. For instance, this teacher is talking about the way in which she encourages children to finish their work:

'Well, of course, it depends on the child. Most children will want to finish something they've started if they are really involved, but they may need a break and come back to it a little later. In some cases I am the one to suggest that they leave it and have a rest if they seem to be getting tired. But there are children who won't come back to finish, and then I remind them. In Brian's case I tell him to go back and finish one thing before starting another,

* From 'Cognitive Development in Children: Development and Learning'. *Journal of Research in Science Teaching*, Vol. 2, 1964 (pages 176–186).

otherwise he would always be jumping from one thing to another. But of course it sometimes depends on what one means by 'finish'. A piece of writing three lines long and a drawing is only the start for Timothy, and I would expect him to continue with it, but for Iain this would be a good product and I would praise it and not take the edge off his pleasure by saying that it could be more. The praise is usually enough to encourage more next time, but if not, then it would be time to say that he should try to do more than he did last time.'

This teacher evidently varies her approach and her expectations for Brian, Timothy and Iain, and for her other pupils not mentioned. She does this in response to what she knows about them and her experience of noticing the effect of different approaches and experiences on them. She probably did not hit all at once on the best way to treat Brian, for instance, but could have tried various approaches to encouraging him to stick at something and finish it. Neither will she keep to this approach if Brian begins to take more responsibility for completing things. The teacher here is matching her approach to the child but arrives at the match by a gradual process of trying things and seeing their effect rather than applying formulae for matching 'treatments' to 'cases'.

It is often not easy to find the 'match' particularly in relation to providing science activities at the right level, and we think it may help if we take a closer look at the process—analyze it and take it apart.

First it may be helpful to recall the main reasons for matching:

- 1 When children habitually fail to understand what they are doing a vicious circle is created in which failure makes further failure almost inevitable. The child's image of himself becomes affected by this failure (see page 69), his response is likely to be one of defeat 'It's no use, I just can't do it' and he may reject even the sympathetic help which is needed to break the circle.

How can we prevent such a vicious circle from being created? We have suggested that it is by finding the point at which a child *can* succeed and where his success is acknowledged, but doing this not just once but constantly so that his experiences keep pace with his developing ways of thinking.

What can we do if a vicious circle of failure has already been set up? Then it is likely to be necessary to search hard and at a much lower level than expected to find a firm foundation where he can feel really sure of success. Take Duncan, for instance:

Duncan had never been any good at maths, and would often say so to various people. At seven he could get by if he was told what to do—and his neighbours would oblige by showing him what they had done. But at eight he was distressed by having to do maths work and frequently burst into tears at the sight of his maths book. Help with particular difficulties sometimes encouraged him but he was never able to tackle new problems for himself. One day another teacher was helping out and sitting at Duncan's table, and he

plucked up courage to ask her 'What does that mean?' 'That' was the figure 8. He knew it was called eight but didn't seem to have connected it with eight of anything. His own teacher was then able to appreciate what was perhaps at the root of his problem with numbers and helped him to understand how sums on paper can represent actions with objects. Then he began to succeed for the first time with simple addition and subtraction.

One way of avoiding the vicious circle is through an atmosphere of sympathetic help in which children feel they can voice their problems and not disguise their lack of understanding. A warm and friendly relationship between teacher and pupil is more than a way of keeping children happy; it is a safeguard against their feeling the need to disguise real learning by rote learning or being 'concerned only to give the reply the teacher wants' (see page 9), and is thus essential for intellectual as well as emotional development.

2 The second kind of argument comes from looking at the influences upon children's learning:

- growth and maturity,
- experience, of objects and of actions on objects,
- social interaction, communication within and outside school,
- the child's response to these influences in adjusting his ways of thinking to accommodate new experience.

An important part of learning involves a slight change or accommodation of existing ideas. Unless children can take in and make some sense of an experience they cannot respond to those parts which present new challenges. There is unlikely to be development in thinking if the demands made are a long way ahead of existing ideas. Hence the argument that learning is most likely when activities are matched to a child's way of thinking but also challenge that way of thinking. Piaget, in fact, gives a theoretical basis for arguing that

children learn best when new experiences are related to what they already know, are novel but not too strange, and sufficiently complex to call for some extension of existing ideas but not outside the range of accommodation.

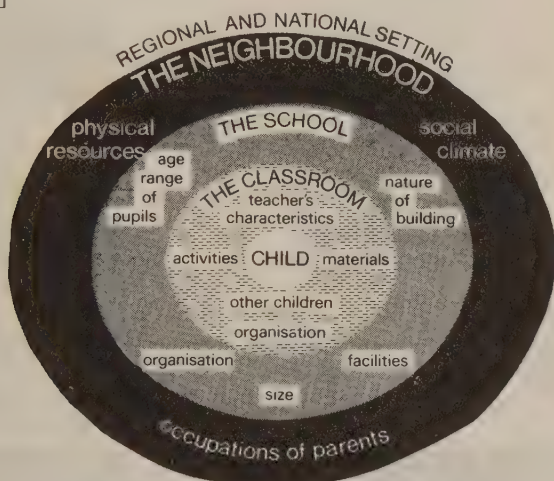
Providing such experiences is what we mean by 'matching'—not just exercising the same abilities and ways of thinking, but advancing them.

Matching in theory (*tape-filmstrip*)

It has been argued that children learn more effectively and enjoyably when their learning experiences are matched to their capabilities. Learning of the kind with which we are most concerned has as its goals the development of abilities, ideas, attitudes, rather than facts which can be learned by rote. In helping children's

progress towards these kinds of goal it is not just the level of intellectual demand of an activity which should be matched to the level at which the children operate, but the attempt to match should affect the whole learning environment.*

[1]



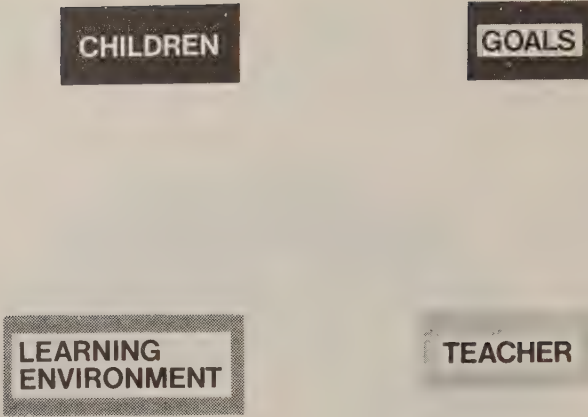
A child's learning environment at school

A child's learning environment extends to all the parts of his environment which can affect his learning directly or indirectly. At school things with the most immediate effect on him are in the innermost circle, his classroom. Here the materials and activities have a strong influence, but so have his teacher, other pupils and the class organization. Aspects of the school affect him more indirectly, but the size, kinds of buildings, age range of pupils and especially the organization (in vertical or horizontal age groups for example) may well have some effect. Even more remote, but not to be ignored is the effect of the physical and social setting of the school, whether it is in the country or city, the nature of the community, and so on.

[2] For our purposes here we shall consider the part of the learning environment which is in the classroom for this is where the teacher's decisions have greatest impact for a child. Although of course there are aspects of the learning environment in the classroom about which the teacher can do very little, many important aspects are subject to her control. So let us consider the main elements in the situation. We have *children, learning environment, a teacher* and a set of goals:

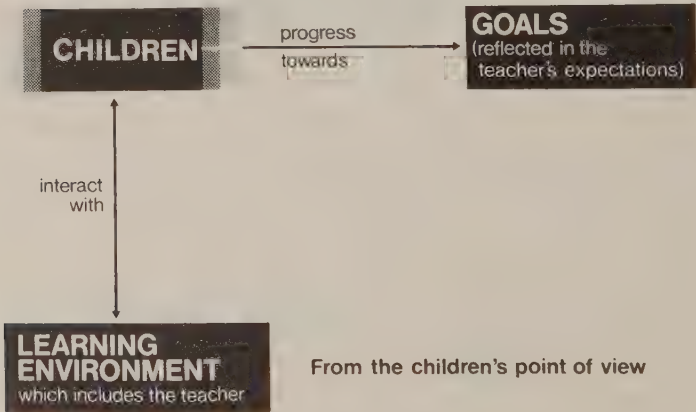
* The concept of learning environment is further discussed on page 125.

[3]



First let's look at the relationship between these things from the children's point of view :

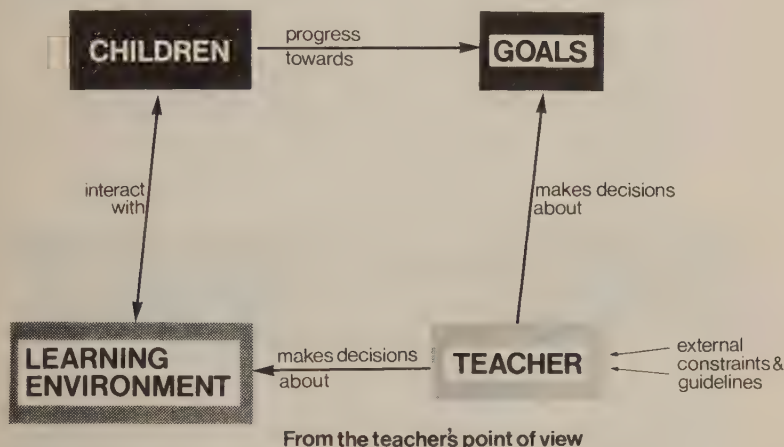
[4]



The children interact with their learning environment, which includes the teacher and make some progress towards the goals. They will not be aware of the full extent of the goals, but know what is expected of them through the teachers' comments, suggestions and guidance. If the learning environment is suitable, the children's interaction with it will result in their making gradual progress towards the goals. We must not regard the situation as in any way static, of course, for the action of the children is changing the children and learning environment all the time, which is why the word *interaction* is used.

Now let's look at the same things from the teacher's point of view. We have to separate her from the rest of the children's learning environment at this point.

[5]



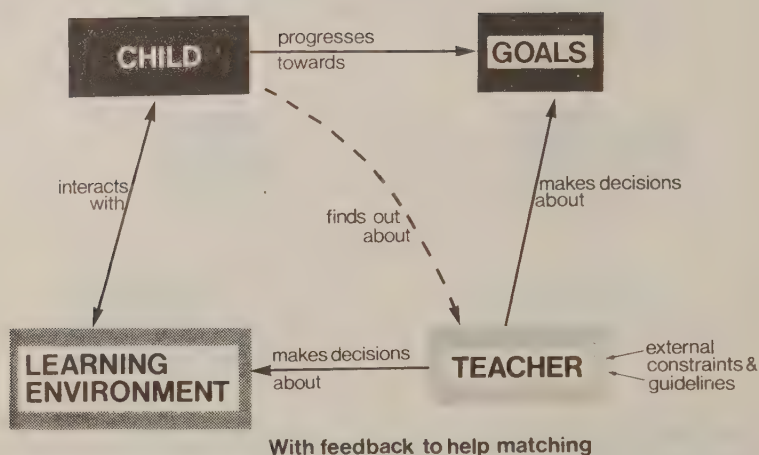
In this diagram the teacher is pictured as making decisions about the learning environment, the goals and the way she approaches the children. All these are decisions she *has* to make, for although she may have general guide-lines to follow and certain constraints to keep in mind these determine long-term planning rather than the moment-to-moment decisions we are considering here.

But if the teacher is deciding about activities and approaches for all the children based only on the goals they are to achieve and various guide-lines and constraints, then she is not taking into account the levels of development of various ideas and abilities of the children. [6] Here there is no attempt at matching.

When the teacher is trying to match aspects of the learning environment to the children she *first* finds out where the children are in their development and then makes her decisions. As each child has different needs so the decisions made for each one are different and we can no longer think of one set of decisions for all the children but have to consider each child as interacting with a slightly different learning environment.

There are two essential differences between this and the diagram which pictured the situation when there is no attempt at matching. One is the addition of the dotted arrow giving feedback to the teacher from the child, representing information gathered as to various aspects of his development, interests, etc. which are

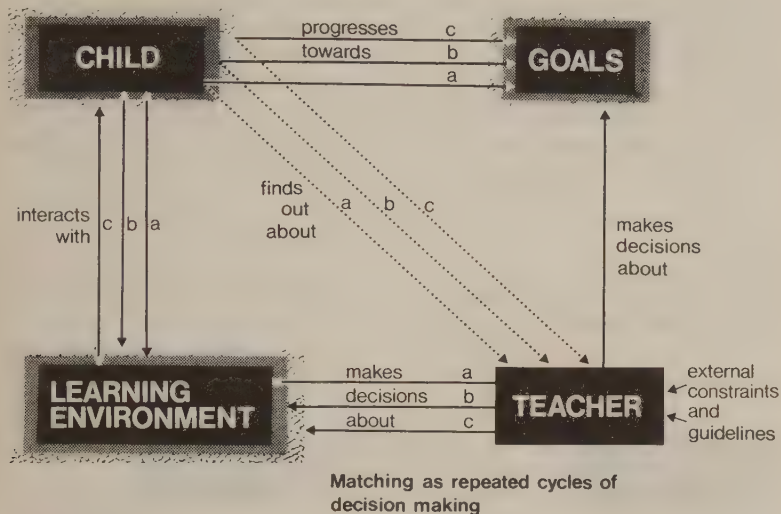
[7]



relevant to the particular situation about which decisions are being made. The second is the replacement of the word 'children' by 'child'; for the teacher here is making slightly different decisions to suit the varying characteristics of each child.

[8] But this picture of events is oversimplified. For one thing, as mentioned before, the situation is not static; the child, the learning environment and even the teacher are constantly being changed by the interaction between them. Each decision by the teacher makes further changes in the learning environment and in the child, so it cannot be a matter of a once and final decision. However another oversimplification which is equally important is the assumption that once the teacher finds out about a child, then she will know how to adapt the learning environment to suit him best. This is unlikely to be true for the simple reason that so little is in fact known about the most effective way to promote progress in children with particular characteristics and at certain stages of development. The teacher has to use what general guide-lines she can find from her own experience and elsewhere, but the result is at best to provide an approximate matching. If she gathers more information about the effect of this decision she will be able to make adjustments which improve the situation, and then follow up with successive cycles of finding out, making decisions, looking again. So 'matching' is seen to be not the taking of a single decision but a process of repeatedly gathering and using feedback. In this way the effect of changes on the child and in the environment are taken into account.

[9]



Here the teacher gathers feedback along the arrow marked *a*, uses it to adapt the learning environment (including her own approach) to suit the child as well as she can. The child interacts with this learning environment and the teacher notes the effects by gathering feedback along the arrow marked *b*. So the repeated cycles go on, with decisions being made which respond to the ever-changing situation. Hopefully the child makes progress towards the goals. We cannot be so optimistic as to suggest that there are not unwanted outcomes, but at least the more damaging ones which arise from serious mismatching—boredom, frustration, a negative self-image—are likely to be avoided because action is taken as soon as signs of their development appear.

[10] Finally some cautions. This theoretical analysis has taken apart the elements and processes in the situation and made them appear more separate and distinct from each other than is really the case in practice. It may be impossible to distinguish a cycle of gathering and using feedback when a teacher is moving from one pupil to another and she herself would certainly not be conscious of carrying out this process. Nevertheless if one asks a teacher who attempts to cater for children's individual needs to explain her actions she will generally rationalize her decisions at any time by reference to knowledge of the particular children involved and appreciation of the goals of their work.

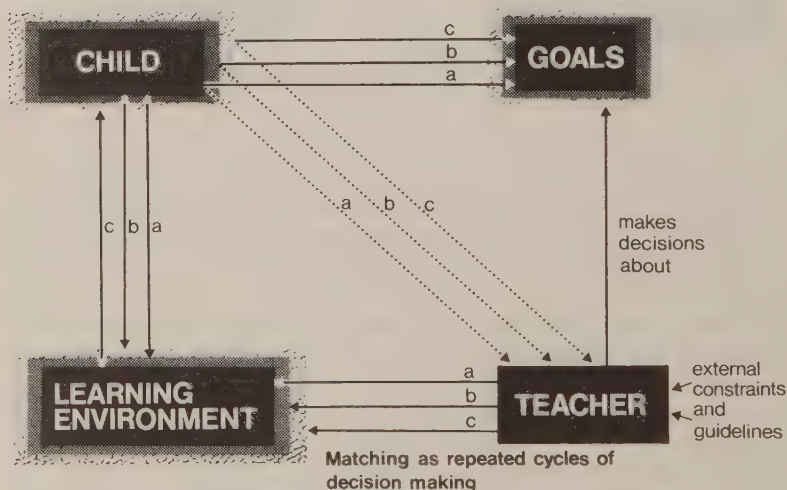
The second point to remember is one that has been made before, but it is worth [11] repeating, that catering for the individual

characteristics of children does not mean that they learn on their own. Different learning environments are not necessarily separate ones. The difference between the experiences of one child and the next may be only in the teacher's expectations of the child, or in the part he plays in a group activity, or in the level at which he tackles a problem or in the responsibility he is given. All these are important for the child but do not preclude children working in groups, interacting and helping each other in their work.

Discussion

The following diagram represents the dynamic view of the process of matching just described.

[9]



Does this model relate to the real situation, as, for instance, in the case of the teacher quoted at the beginning of this topic?

Are you satisfied that the model is a useful one to use as a focus for discussing the issues about matching in general terms?

If so, there are two important questions to be faced:

- 1 What features or aspect of the learning environment can be changed?
- 2 What kinds of information should the teacher gather about the child?

Again it might help to work from an example. Here is how one teacher explained her decisions about a particular ten-year-old child in relation to activities with a construction set which contained wheels and gears which could be driven by a motor:

*Martin surprised me with his enthusiastic reaction and wealth of ideas. He's always so quiet normally and more willing to follow than to lead. I didn't give them the motor at first, thinking that it might be too much the centre of attention and prevent them seeing what they could do with the other components. It seemed that in no time at all Martin built a mobile crane which was really good to look at as well as working properly. He seemed to be able to pick out the pieces he wanted very quickly and fit them neatly, whereas the others were having to do much more by trial and error, and their results were unstable and rather messy. Some of the children have this set at home so I asked Martin if he had it, and he said no, he'd never done anything like this before.

I produced the motor and a battery and asked him if he'd like to try making his crane work from that. He mounted it on the body of the crane and arranged for a drive from the motor to turn the wheels so that the whole thing moved along. I thought perhaps he might like to make the crane hook move up and down with the motor, and said so. He needed some help to see what might be done, and it was soon obvious that the motor was going too fast and intermediate gears would have to be put in. I left him with this problem. When I came back he'd gone back to his first idea of using the motor to drive the wheels and was explaining it to the others. They asked to take it outside to give it a longer run in the playground. I agreed, and didn't return to the subject of gearing down the motor.'

First consider question 1 in relation to Martin.

Decisions made by this teacher about Martin's *learning environment* included

- her *expectations* of him and the *goals* she had in mind. (At first her expectations were too low, then too high and were eventually set at the realistic level where he was enjoying success)
- the *materials* and *activities* provided. (She responded to his progress by producing the motor rather earlier than planned),
- the *freedom of choice* which he was allowed. (He decided to make the crane and wasn't forced to pursue her idea of how to use the motor.)
- the *interaction with other children*. (He showed them what he had done and involved them in trying it in the playground.)
- the *organization* of the class (was one which provided for this kind of group work and initiative).

She could well have made a different set of decisions, for instance, to tell the children what kind of model to build, or to provide a work-card, to arrange for a certain group to work with particular parts of the materials, etc. The result would evidently have been different, because of things decided by the teacher.

It would be useful to widen the discussion to other situations and to draw together aspects of the learning environment about which a teacher *has* to make decisions, and which could be adapted, if she chooses, to suit the characteristics of individual children.

Make a list, compare with what others have written and discuss any differences.

Now turn to question 2.

What information about Martin was gathered by his teacher in this activity and used in making her decisions about the learning environment?

She noticed:

- his immediate interest in the material,
- his manipulative skill, in fitting the pieces together,
- his spatial ideas, in picking out the pieces he needed.

She inferred

- that he had well developed ideas of mechanical cause and effect,
- that he was not ready for work involving gear ratios.

and she found out

- about his previous experience of this kind of activity.

Again it is possible to say that she might well not have noticed these things, and on the other hand she could have noticed *other* things or found out more information.

Thinking of other situations as well as this, write down what you think is the information a teacher should try to find out about her children in order to make decisions about their learning environments.

Exchange ideas with others and add to your list if further important aspects are suggested.

Theme A: 'Making and Recording Observations about Children' takes up in detail the subject of gathering information about children, so we do not go further into this aspect here. We now turn in the next topic to the discussion of various approaches which teachers use in practice to provide each child with a supporting and encouraging learning environment.

Topic 6: Matching in practice

The purpose here is to appreciate that matching is in practice a process of approximation and to recognize the advantages and disadvantages of different approaches to bringing it about.

Children should be able to do their own experimenting and their own research. Teachers, of course, can guide them by providing appropriate materials, but the essential thing is that in order for a child to understand something, he must construct it himself, he must re-invent it. Every time we teach a child something we keep him from inventing it himself. On the other hand, that which we allow him to discover by himself will remain with him visibly for all the rest of his life.

Piaget in *Play and Development* ed. M. W. Piers

Piaget is here emphasizing once again that children learn through actions and activity with things around them better than through being told about things of which they have no direct experience.

Fine in theory, but what can be done in practice?

Perhaps if there were only a handful of children to one teacher it would be possible for them to invent things for themselves, but what about 35 or 40+ at once?

Can a child invent everything? Are there things, such as conventions, signs, symbols, which have to be taught?

Is it practicable to give children a free choice of what to do and how to do it?

What, if anything, is the teacher's role in extending and developing children's thinking and feeling?

These are the kind of questions which we face as we turn from the theory to various approaches to putting matching into practice.

First it may be useful to draw together some of the relevant points made, and examine their implications for the teacher's role in matching. The following section can be read or heard on tape.

The teacher's role in matching (*audio-tape*)

The study of children's development and the factors influencing it have reinforced everyday experience that all children are different from one another, and that each is unique in the stages reached in various aspects of development. This is a fact which it is hard to deny, but not everyone agrees as to its consequences. Some say that the aim should be to make all children equal and that the way to do this is through giving them all equal experiences. This ignores the fact that because of initial variations between children similar experiences would not mean the same at all to each one—some would understand and make progress from the same experience which would leave others mystified and worried. If similar experiences are given to children the gap between the more and less advanced widens, it does not narrow; research has verified that this is the case. The view which we have taken is different; it is that children have a more equal opportunity to develop their capabilities to the greatest extent if their experiences are not the same but are suited to their individual characteristics. There is no conflict between catering for children as individuals and encouraging them to work together in groups, helping each other and learning to co-operate and share with others. Within

the group the individuals can still operate at their own levels and experience success even though one may be achieving at a higher level than another.

It is easy to agree with this in theory but more difficult to translate it into practice. A teacher frequently feels that he or she should try to 'hurry along' a child who can manage only the simpler activities; it seems wrong that he is behind the others and right to help him catch up. But this feeling of failing with this child arises from implicitly judging all children by the same standard of attainment or progress. If the child working at a lower level than others is succeeding at that level and is deriving satisfaction from his work, then the teacher is also succeeding in helping him. At the other end, with children who have developed more rapidly than others, there is an equal danger in having the same expectations for all. A child who can work at a more advanced level will be bored and under-occupied by activities which provide a worthwhile challenge for others. The fact that this child succeeds is not something about which his teacher should feel content if success is accompanied by signs of boredom and disinterest. He may not be experiencing the challenges which really make him think and develop mentally, and his teacher is failing unless he meets such opportunities. Thus each child's progress has to be judged in terms of expectation based upon knowledge of that child.

The level or complexity of ideas involved in activities is not the only aspect to keep in mind in matching, as we have seen. There are other characteristics to consider; interests of individuals are captured by different things and in different ways; the materials and situations which motivate children to explore and find out vary from one to another; the need for attention and help of different kinds also varies. It seems a long list, but many items relate to things which teachers instinctively do when they get to know their children as individuals. Knowing the children is the basic essential, and we have seen how much this process can be helped if we consciously take in information from the children, by listening and attending to what they have to say and by looking at the way they go about their work. Armed with the knowledge of his strengths and weaknesses, we can adapt the main features of the child's learning environment to give him the best chance to develop.

Even if we accept this we have still to face our original question of how to help progress. Each child is somewhere along the line towards achieving the goals and, whether he is further along or not so far along, we have to help him from one point to the next. If we knew the answer to how to do this then education would be an exact science; we could build a child's learning rather as building a house, knowing exactly how one brick should be placed on another in the sure knowledge that at the end of the process a complete

building would be achieved. With children's learning the 'bricks' (if we extend this metaphor for a moment) are not ready formed, they have to take shape gradually and will not bear the weight of anything we attempt to build on them too soon. We have to do what we can to allow each brick to become firm, and add to it only a small load at a time.

Coming to the real situation we can find out through observation about how firm are certain bricks, that is, how well a child has developed a certain skill or way of thinking. Although we don't know exactly how or when to help him make the next step, we can make use of this knowledge that we have about where he is at present. Acting on this information we can give him plenty of opportunity for enjoying and using his present skills with success. If he then encounters more complex situations in which he has to extend these ideas and skills he will be more able to attempt these and to succeed if he has consolidated the ideas and skills in the first place. If he begins to fail too often then we know the situations are too far ahead of him and he should return to the level of activity where he can succeed.

It all sounds very 'hit and miss' -it has to be, because we just do not know the detailed succession of steps which is going to make the right match for every child. Fortunately the teacher is not working in the dark alone; the children are there to help. They are the ones who really know whether they are frustrated or confused, whether they want more time to get a better grasp of an idea or want to move ahead and they could play an important part in matching. Given the choice no child would want to be bored or bewildered and there is reason to think that in a learning environment free from competitive and other pressures a child could take a part in the responsibility for his progress.

There are differing opinions about the extent to which children should choose their activities or whether these should be decided by the teacher. In some cases pupil choice is inevitably limited by circumstances such as the provision of materials. But the question is only part of the wider issue of the teacher's role in children's learning. The kind of intervention by the teacher can make all the difference as to whether or not a child really benefits from an experience. If there is no intervention children might pass over things, which if brought to their attention, might have helped their thinking. It is debatable whether this is better or worse than the kind of teacher intervention which amounts to interference. A teacher who is constantly asking questions or telling the children what to do, however gently, is directing the work along the path which she thinks it should go and the children are not finding their own way, the way which helps them to make sense of the experience and is probably known only to them. If instead she

discusses the work with the children so that they tell her what they think and ask her questions, she can make suggestions and bring in new ideas in a way which leaves the children free to use these in their own way.

This kind of interaction between teacher and child, taking place within a learning environment which includes a range of materials and activities carefully selected with the needs of the children and the goals of their education in mind, probably provides the best conditions for children's mental, social and emotional development.

The teacher's role is described here as a crucial and active one. But it is acknowledged that the teacher cannot know exactly what step is the right one for a child to take next, and that the child himself is in a better position to know what challenge he can meet.

Some would put different emphasis upon the child's ability to choose what is suitable for him and the teacher's ability to suggest what may be worth while. The following are the approaches of different teachers. They focus largely on these main issues of pupil choice and teacher's role.

- 1 'Create the right environment, develop the right expectations, provide the most stimulating activities and resources possible and leave the children to do their own matching as they are uniquely fitted to do. During their first five years of life by employing just these methods they learned more than they will ever again achieve in any comparable period. This learning included the mastery of their own language to a fairly sophisticated level and it has all come about through the matching of their needs to the environmental resources around them. These resources included of course the mother figure and the other human beings they have encountered. Always they will extract from a situation the stimulus or the material they intuitively know they need or can use.'

(Headmistress of Primary School)

- 2 'You've got to push things into the child's way without being overbearing. You've got to make sure that, if one child begins to do something you brought in for somebody else, there are things available for the other child; you've got to make sure that there are the right sort of books to lead children on; that material is there that can be worked with.

I could never just walk into a class and say to the children, "You can choose what you like and do what you like," because I know that some of them wouldn't know what to do, or would feel negatively about certain things. They might hesitate to paint, for example, because they hadn't had enough experiences with material.

You must start by giving children lots and lots of experiences and lots of techniques, so that there can be meaningful choice. In other words, you can have painting available in the room, but that in itself doesn't provide choice. In this situation the only choice may be in deciding what to paint.

The teacher must take a wide variety of materials into her class, or be

prepared to support activity in a wide variety of topics. First she needs to help the children learn to make choices, and then she must provide an environment in which choice is real and meaningful.

I don't structure topics. I make cards, covering a wide range of information, available, and the children select what information to work with. If they say "I want to do some more about this; I know there is something in this book," that's great. But it's a slow process.'

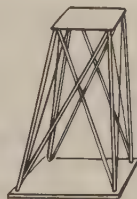
A Junior School Teacher in *The Teacher's Role*,*
Cook and Mack (pages 53-54)

The following extract from an account of a class project on timber provides a specific example of another teacher's way of working. The children are eleven-year-olds.

- 3 'Two boys have become interested in making a model of a fire watch tower. They carefully measured and cut out two squares of wood and fitted four laths to the squares, so:



On a visit to the class the headmaster admired it but pointed out how insecure it was. I directed these two to work-cards (in number) used by the top ability group. The cards directed the boys to the shape box where there are strips of card and paper eyelet fasteners. They had to make a four-sided figure and a three-sided figure and compare them for strength. It was obvious, and they gleefully showed it to me and to other friends in the class. Here was the answer to their problems. The card asked them to find out places where this strong shape is used and they have noticed many already. They made their four-sided figure strong by joining two corners with another strip, and practically bowled the Head off his feet the next time he came in showing him what they had discovered. Now they are applying this knowledge in their model.'



Another teacher explains how she used work cards for a class project on trees.

- 4 'I prepared several sets of cards on the theme of trees—one set on geographical topics, one set on studying different kinds of trees, one on the uses of different kinds of timber, and so on. The children worked in groups, which I decided because I wanted mixed ability and had I allowed them to choose they would work with friends of about the same ability. For some activities they had to work as a group, for the practical part anyway, but for some the children within a group could each work at their own level and at their own pace.'

* London: Macmillan, 1971.

Examples of work-cards:

BEECH



Before we had paper, words were scratched on beechwood and bark. 'BOC' the old word for 'book' also meant 'beech'.

Things to do:

1. Find a beech leaf and do a rubbing of it.
2. Find information about the beech in the 'tree' charts and copy it carefully into your worksheet.



This chair is made of Yew wood which *turns* well.

What do we mean by 'turning' wood?

Find out as much as you can about the YEW tree.

In what century was this chair made?

What are the advantages and disadvantages of these approaches?

The four approaches exemplified here can be typified as

- 1 Free choice with a carefully prepared environment—the children do their own matching.
- 2 Choice mixed with activities initiated by the teacher so that children experience things they may not have chosen freely; matching is through teacher's decision about range of activities and children's choice from within this range.
- 3 Teacher takes initiative to provide experiences when she observes that the children could benefit from them; more influence of teacher in matching and less of children's choice.
- 4 Children choose activities from among those provided by the teacher. Pace of working can be matched; little chance to match other aspects.

You may like to add one or more approaches to this list so that the following discussion can encompass a more comprehensive range.

Looking back at the characteristics of children which are relevant to their learning and which should be taken into account, how well do these approaches provide for 'matching' to these aspects?

Approach	1	2	3	4	5 (if added)
Variation for					
Interests					
Attitudes					
Intellectual level					
Manipulative skill					
Previous experience					
Rate of learning					
Preference for learning in different ways					
etc.					

You might use a system of stars—** for catering well for matching to a particular aspect, * for fairly well, and 0 for little possibility of matching.

Remember that being able to vary an activity in some respect is not enough for matching; what is important is that the variation suits the child.

Theme C: 'Making Decisions about the Learning Environment' goes into more detail of ways in which organization, teacher's approach and activities can be adapted to suit children's characteristics and development.

Theme C: Making Decisions about the Learning Environment

Topic 1: What can be varied?

The purpose in this first topic is to appreciate the variety of features in a child's surroundings which affect his learning, and to recognize those which can be varied at the decision of the teacher.

Introduction

The focus of this theme is what teachers can do to provide individual children with opportunity and encouragement for learning. Children's learning and development is the subject of a separate theme in which the importance of adapting experiences to variations between individuals is discussed and the concept of 'matching' is considered in detail. Here the concern is not so much with the arguments for providing children with different experiences but with suggestions for how to do it.

The problem can be found in almost any classroom. Consider Nigel and Jill.

Nigel and Jill

They are both eight years old, in the same class at school, live near each other at home and play together both in and out of school. Nigel is short in stature, wiry, very active and a quick mover. He is a cheerful child, with many friends; very little seems to upset him even though his development of basic skills is quite a bit below average, and he doesn't enjoy practising them. He just gets his writing and number work over as quickly as possible and his teacher's urging to try harder, do more and be tidier roll off him like water off a duck's back.

Jill, on the other hand, reads avidly and fluently, more at the level of an eleven-year-old. She is well developed physically, is taller and heavier than Nigel. She is rather too plump and this inhibits her physical ability though she is nevertheless active and enjoys games and P.E. Her writing is very satisfactory both in content and appearance; she learns quickly and seems really to enjoy it. She likes to be praised for her good work and is sensitive and moody if the teacher takes it for granted that she does more in quantity and quality than others.

Jill and Nigel sit at the same table; one of the things which happen each week is a test of arithmetic and spelling. The teacher writes twenty sums on

the board and twenty words which have been learned that week. Jill is used to getting all of these correct; generally she doesn't have to 'learn' the spellings as she knows them already. The sums are also easy for her and the only pleasure she gets from this test is the anticipation of getting twenty out of twenty. Nigel generally gets less than half the spellings correct, and has been known to get hardly any sums right. After the test the teacher goes through the sums on the board. The whole process of the test takes at least an hour; a regular event in which Jill is bored and Nigel bemused. At other times there is more opportunity for Nigel and Jill to work on different activities, but for both children many of their experiences do not contribute as much as they might to extending their ideas and developing their ways of thinking and feeling.

We could, similarly, point to differences, perhaps not so obvious but equally important, between all children in the class. The experiences from which one learns best are not the same as for another, and *without denying the value of a class getting together* for discussion, stories, games, planning, exchanging news and general directions, it is evident that on other occasions differences between the children should be reflected in differences between their activities.

'Learning environment'

From the earlier discussion of what kinds of things can contribute to a 'match' or 'mismatch' it is clear that we are concerned, when attempting to match, not just with the intellectual demand or skills required by an activity but also with the social situation, the atmosphere, the approach of the teacher, the expectations felt by the child, the attitudes of teacher and pupils, and more besides. The phrase 'learning environment' is used as a way of covering all of these aspects.

The learning environment includes all the external objects, persons, conditions and circumstances which effect a child's learning.

What children say sometimes gives clues to what has influence on their reactions:

'I've done something like this before, it's good.'

'Oh not that again!'

'I can't work with Julian, he's too silly.'

'My Dad says it's not right to spend time in school on things like this.'

'Heard all about this on TV.'

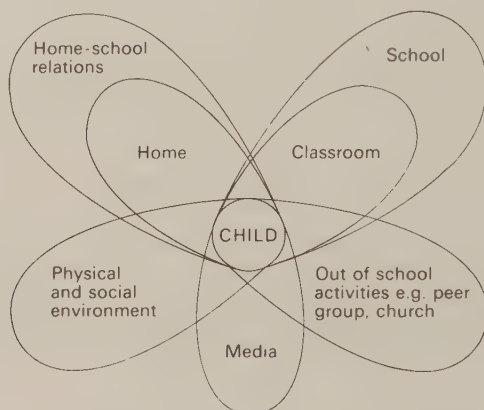
'I can do it if she only gives me a chance.'

'It's horrid when people laugh at you just because you didn't understand.'

'I wish she wouldn't ask us to find things out at home. My Mum never knows and we've got no books.'

'I've seen a real volcano, in Sicily.'

Past experiences and present conditions both within and outside the classroom are reflected here. There are also many other influences of which a child may be unaware or which he does not consciously acknowledge. Putting them together gives a picture of the wide extent and complexity of the learning environment.



The main elements in the child's learning environment are the home, school, physical and social environment, the media, and activities out of school and home (scouts, church, peer group, hobbies). As well as each having their own influence, more prominent at some times than at others, they also each combine with other influences e.g. when the child is at school the most immediate part of his learning environment is the classroom, the school itself having a general but more remote effect, and the home, media and out-of-school conditions and activities being more in the background but nevertheless being influential. At home the influence of the school is then less immediate but nevertheless present, particularly as it is represented in home-school relationships.

Having considered the complex whole we now return to consider one part of it, the classroom, remembering that it is only one part.

What are the main aspects of the part of the learning environment which is inside the classroom?

Draw up a list of what you consider to be the factors external to the child which affect his learning, ignoring for the moment whether or not they can be controlled or varied by the teacher or anyone else.

Discuss your list with others, adding items which come from their suggestions.

What aspects can be varied by the teacher?

Separate from your list those aspects of the learning environment which are subject to decisions made by the teacher. What variations can be

made in each? It may be useful to keep in mind Nigel and Jill and think about the variations necessary to cater for their differing needs. Three examples are given which may help, but do not necessarily feel constrained to complete a table in this way.

<i>What can be varied</i>	<i>How it can vary</i>
e.g. Interaction between pupils	Very little talk or working together $\longleftrightarrow$ Free discussion and mutual help
Time allowed for particular activities	Same for all $\longleftrightarrow$ Flexible, according to individual's needs
Physical arrangement of tables or desks	In rows facing the front $\longleftrightarrow$ In groups, varying with activities

Are variations made in practice?

It is not profitable to try to decide what decisions about these aspects are 'better' than others:

- there are times when it is best for children not to talk to each other, occasions when they have to spend the same time as each other on an activity, etc.
- at other times it is best if the children talk freely and help each other, and take the time they need to finish their work, and so on.

It is more important to ask whether these things *are* varied to suit the situation and the children and what is the basis for the decision at any time?

Consider your own classroom. What variations are made in the aspects listed above during the course of a week? What reasons can you give for your decisions when things are changed? These reflections will be useful in the succeeding topics, where we consider the decisions about the learning environment under three main headings:

- decisions about organization,
- decisions about activities,
- decisions about the teacher's role.

Topic 2: Classroom organization and constraints

The purpose in this topic is to recognize the forms of organization which are best suited to achieving various goals, and to appreciate the value of variety and flexibility in organizing for the purpose of different kinds of work.

There are two aspects of classroom organization to consider—the physical arrangement, of furniture and materials, and the method of working, the organization of activities. In both cases the organization is not accidental but generally carefully thought out to achieve particular purposes. It is this relationship of organization to the ends it can help achieve which we will be looking at particularly.

Physical arrangement

In general there is a reason for the way the furniture in the class is organized, e.g. if tables or desks are in rows

- the teacher probably spends most of the time talking to the class as a whole and this is the best way for the children to see and hear her, and to see the blackboard without strain.

If the desks or tables are in blocks or bays

- the arrangement helps children to get on with individual or group work.

If the teacher uses large areas for displaying children's work

- this provides an incentive to produce work worthy of display and a sense of achievement in those who succeed in this.

But a teacher can rarely organize her classroom exactly as she would like, for the physical limitation of the room or of the type of furniture, or other constraints, confine her freedom of movement.

However it may be the very existence of constraints which forces a teacher to think about her organization in terms of her own set of educational priorities. Here are some examples of different organizations and the reasons which teachers gave for them.

'Four classrooms' (*tape/filmstrip*)

(a) *Infants teacher*

(Large primary school, buildings dating from the turn of the century)

W. H. [1] You said you had 33 children in your class. What ages are they?

TEACHER The youngest children are rising fives, though in fact there's one child who's not five for another couple of months, and the eldest is seven, at present, so it's four plus to seven.

W. H. Oh, I see, you've quite a range then?

TEACHER Family grouped situation, complete infant age range.

W. H. [2] Yes. Now you've got your desks, er, and tables all in groups...

TEACHER Yes.

- W. H. Now, have you said to yourself, why do I do it this way?
- TEACHER Basically because I don't like the rigidity of one to one rows across the classroom...um...because the children have got the apparatus in a particular area and they can go and work there rather than go and fetch stuff...
- W. H. I see, so that they don't have to work in their places?
- TEACHER No. They don't have a set place. It often works out that a particular group may sit for some time at a particular table, only because they're using that apparatus over a length of time.
- W. H. That's interesting. They don't feel that they need a place that they call their own and they don't squabble over saying...
- TEACHER No.
- W. H. ... this is mine?
- TEACHER No, I've not found this at all. Perhaps once they've established themselves at the beginning of the morning they say then 'I'm going to sit here', then there might be a problem of 'You're sitting in my seat', you know, but not across the whole range of the classroom, no.
- W. H. [3] I was intrigued by the sort of central island that you created.
- TEACHER I don't know why that came about, it just happened. Oh, it's the nature table and it was at the side of the classroom and the only time I found the children really went and looked at it and worked around it—or they could only get to one area of it—um, was when they were going out or coming in. So now, it's part of the room. It's in the middle. It just means that we can use the whole of the table, if you see what I mean, they can look from every angle. Whereas before it was a case of something was at the back and the little ones couldn't see it because it's a high table.
- W. H. [4] Yes, it's a good idea. And you think it has worked? I mean do they seem to have taken more interest?
- TEACHER Yes, they have. They can now go and pick things up and look at them and put them back and they can, you know, all see more and they're taking more interest in what goes on there.
- W. H. One area by the window has a carpet in, am I right, where they had the logblocks laid out?
- TEACHER Yes, the children were working there. The children can go there. Most of the reading or story books are in that area. Their actual, um, our schemes and our

- graded readers are all set out in that area. [5] Books brought in from the library are in that area, so it's really a reading area. We also use that as our coming together, our central...
- W. H. Home base, sort of thing.
- TEACHER Yes. We go there first thing in the morning and we go there usually when we've finished our work. Usually, like after lunch period, now, children who have work to finish will come in, sit down and continue; those that have finished their work, they'll go there—either remain if they want a quiet activity or go off...
- W. H. And that's where you discuss with them what they're going to do?
- TEACHER Yes. That's where we sit in the morning, talk, discuss, and generally everything comes up from there.
- W. H. ... starts from there, yes. Do you have any sort of timetable at all or routine?
- TEACHER Only... the, um, if one considers timetabling the only problem is P.E. ...
- W. H. Yes, the use of the hall.
- TEACHER [6]... and outside activities, outside the classroom. Obviously we use these so that it works in with the rest of the school. Not—and of course anything like television which comes at a set time—not a set timetable, no, I wouldn't use the word timetable at all.
- W. H. No, but in your own mind do you say 'Well, we'll do the basics in the morning and something else in the afternoon' or do you just let it come?
- TEACHER Yes, it often works that way. I have found that with the younger child—I'm talking about now the sort of, say the sixes-sevens sometimes can adjust and go back to work later, but with that group of young children they often have to, their optimum time is in the morning when they first come in, and they give a lot more then. It depends, of course, on the activity. I mean, sometimes it can work back from creative activity...
- W. H. Yes.
- TEACHER [7]—you see, in which case—this is the reason why I've fought to get, in such a small place, a painting table.
- W. H. I noticed that, yes.
- TEACHER I mean, really you know we're a bit cramped in certain areas and people say well—this—but I'm not giving it up because then it's there immediately a child wants to go and make use of it.

- W. H. Yes, that's a good idea.
- TEACHER Otherwise it means we've got to uproot a few more. [8] We do have the area outside of the classroom, but the children aren't as supervised—but that's taking them away from the, the—perhaps even the stimulus that caused them to want to go and use the facilities there.
- W. H. [9] What's your answer to, I mean the teacher I was talking to this morning who has her desks in rows was saying, well, you know we have realized that we're missing out on the ability to apply this rule in English and this rule in arithmetic in this informal work. Now do you think that you miss out on anything like that with the children?
- TEACHER What, you mean by ...
- W. H. ... the formal stuff, you know. You can get it done in this informal atmosphere equally well do you think?
- TEACHER Yes, certainly. I don't think this morning any of the children are doing anything this way. It comes, 'cos obviously, what I've done with the children themselves, grouped them ...
- W. H. Mm.
- TEACHER ... now that's all in *my* mind, not in theirs, and it's ability basically and usually it's a stage of work, in particular work that we cover.
- W. H. Yes.
- TEACHER ... like we use a Fletcher maths scheme and we obviously work with 'Break-through' material. [10] So the children will be at certain stages, and that particular group will go to work in an area, chosen for them, to go and do some particular formal work which I will go with them and work with them. So it's, you know ...
- W. H. Yes.
- TEACHER ... the other children are carrying on. So I cannot see that, you know, that anything should be lacking.
- W. H. And, er, what do you see though as the benefits of this way of working for the children?
- TEACHER The absolute benefits? Well, the fact that they're independent of you, this is the important thing I think. [11] The fact that they know where they can go and find everything. They can immediately get on with it, unless, of course, it's something they desperately need to come and ask about. And—they can set off on their own almost immediately. In the morning, once we have said 'This is your work pattern for today'

and, say for example, I might say that this particular group—of course we've given them names, which is another way I find of making life easier for me, basically I don't have to say 'Oh Fred, Harry, Ben and so on you're going to work here' but 'Oh you children' (*using the group name*) 'are going to work here'—and, so the children straight away go and find their books, take their material, go to their area, sit and work. And then when they want help they'll come back to you. But it means that it comes from them and they go off and do.

W. H. So, I mean this is the reason why you don't have any centre point in the classroom. You don't have a—I didn't notice whether you had a desk or not?

TEACHER No, my desk is the nature table, 'cos it's a nice large area. Um...

W. H. [12] And there's no blackboard...

TEACHER No, if I need to write—no, again that's lack of board space for creative work or any work that's going up on the wall. There is one there, it's covered. Um. If the children need to work with a board of some description I usually use sheets of paper and we usually use one of the children's smaller easels. And then in fact you can take it to the group of children who need to be using it, if they need to refer to something on a board. [13] You know, I just use a sheet of paper pegged to the—there was one at the back of the class. Or back, or whatever. Sorry, what was the previous question?

W. H. Well it was about your own desk. I mean you have nowhere for you...er... You don't have a base where they come to you 'cos you're constantly moving.

TEACHER No, I try to get to them. Obviously they do come to me and, you know, this business of the queue waiting for this and waiting for that, if I can move around I can usually cover a group of children rather than just one. The only problem is when you come to sit, basically for the one-to-one reading situation, say reading a story book, then the case is that I usually either go to them or we perhaps go together to the quiet corner.

Notice that she had reasons—whether or not you agree that they were worth while—for the arrangement of the furniture so that there was—

- a quiet corner,
- room to get all round the nature table,
- a permanent painting table,
- no visible blackboard,
- no teacher's table.

The school had also provided an area outside the classroom for occasional use by the children. (This was in an area previously used as a cloakroom and now set up with sand, water, a large wendy house and large construction apparatus. It is supervised by Mothers as part of a regular organization for involvement of parents in the working of the school.)

(b) Junior teacher (1)

{Fourth year class in another primary school which was built at about the same time and to the same pattern as the previous one.}

W. H. [14] What I'm trying to do is to relate what you see in a classroom to what it's intended to achieve. You know, what are the reasons for the organization. In some classrooms you go in and you see the children moving about all the time. In yours it's very obvious that they don't.

TEACHER [15] Yes.

W. H. So, can you say, you know, the reasons for that?

TEACHER Well, you see the main thing—I can't stand any noise. I don't allow them to talk in the classroom—

W. H. Yes, the silence was . . .

TEACHER You know, I mean. I just can't stand noise and I can't stand children walking about.

W. H. Um.

TEACHER I mean they go out at playtime, they go out at dinner-time and so on. But, um, actually in the classroom I like them sitting in their places where I can see them all. And I mean I teach from lesson to lesson. There's no children all doing different things at different times. You know, it's all, er, it is formal, you know.

W. H. Yes.

TEACHER And of course I like it that way, I believe in it that way. But er—of course . . .

W. H. [16] So, um, they actually do everything at their desks do they?

TEACHER Yes, Yes.

W. H. So the bookshelves are there for them to go and take a book and then they return to their desks?

TEACHER That's right, yes. Well, I mean they choose a book

- from the shelf, yes, and they keep it in their desk and return it when they've finished with it. But the actual lessons they're all done at their desks.
- W. H. Yes. There's a difference between doing things at desks and doing them at desks which are all facing to the front. Now is there any particular reason for that?
- TEACHER Well because I think, again, if they're sitting in groups it—it encourages them to talk and I don't like it—
- W. H. Yes, I see.
- TEACHER You see, whereas if they're all facing me, and I—well I can see them and [17] I can see what they're doing. Because quite honestly I don't think that—when they're in groups, I mean all right they might be, if they're talking, they might be discussing their work. But I mean how do you know?
- W. H. Um.
- TEACHER They might be just messing about.
- W. H. Yes. And, er, so they do quite a lot from the black-board, that's presumably another reason for . . .
- TEACHER Yes.
- W. H. . . . turning that way. Do they ever work together at all?
- TEACHER (*Pause*) Only in—when they do painting and things like that. I put the desks in groups for painting simply because it's easier to put the stuff out.
- W. H. You need a larger area, then, don't you?
- TEACHER Yes, but, um . . .
- W. H. [18] There was a round table at the back with some cards on.
- TEACHER Oh yes, they're sum cards. If they've finished a piece of work that I've been, um, you know, doing with them—well off the board or anything whatever, you know,—if it's maths then they carry on with one of those cards.
- W. H. Mm, I see. And have you got any particular organization of the day, you know, sort of the basics in the morning and something else in the afternoon, or . . .
- TEACHER Oh, it varies. I usually stick to maths in the morning but not always. I mean, it so happens if I want them to get some English done in the morning, well, I'll do that first . . .
- W. H. Mm.
- TEACHER and then, if I've got my class in the afternoon then I'll do the maths then. That really doesn't matter. But I mean I do really stick to timetable.
- W. H. Is it your own timetable or one that the school is, er?

- TEACHER Oh no, it's, um, well there is a timetable for everybody because we change over such a lot. You see I take lots of classes for music.
- W. H. Oh I see, yes.
- TEACHER So therefore somebody has to take my class, like this morning, I go out for hymn practice and then somebody takes mine for history or something, you see.
- W. H. So, I see, so it is laid down.
- TEACHER [19] Yes, it's formal, formal set up.
- W. H. Yes. Is there any room in this for science?
- TEACHER Ah well, I don't take my class for that. Mrs. F. takes mine, she's a part-timer.
- W. H. Oh I see.
- TEACHER And she comes in in the afternoons and she takes mine on Friday for that.
- W. H. Ah, and does she find she has to . . . I mean can she work within the same organization of the class?
- TEACHER Oh she's formal, just like me.
- W. H. Ah, I see.
- TEACHER Exactly the same . . .
- W. H. So what sort of things does she do?
- TEACHER . . . and history and the geography, it's all the same.
- W. H. [20] So it really means that the children are, um, they can't do very much, they work from books and papers rather than things.
- TEACHER Yes, it's from books and blackboard and, um yes, that's it—work-cards, but, um—I mean I don't know what Mrs. F's doing at the moment in science with them, but as far as I know it's from textbooks, the same as, you know, what I do.
- W. H. I see. Does she bring any equipment?
- TEACHER Occasionally, I've seen it, but not a lot I don't think. Only she has done, when they've been doing something on snails or something like that. But, um . . .
- W. H. Yes.
- TEACHER . . . it varies really.
- W. H. [21] Is that piano in the room, is that used, or is it just a place to store it?
- TEACHER Oh yes. No I use that when, er, I have other classes coming to me for music you see . . .
- W. H. I see.
- TEACHER . . . and of course I can't use the hall all the time because there's P.E. going on and country dancing and so on. So they come into my classroom, and I use it for that, you know. But it, er, the third years I take for music and then Mr. R. and Mrs. T. they

- usually take the fourth year.
- W. H. Mm. I see. And, er, the children tend to do all the same, at the same time you say?
- TEACHER Yes.
- W. H. [22] And what do you do with the ones who fall behind—the slower ones?
- TEACHER Yes, well you see they are a B stream. I mean I know there are bound to be some who are a bit better than others, but, they are a B stream, and it's amazing actually...
- W. H. ... Oh, I didn't realize the school was streamed.
- TEACHER Ah, well the fourth years are.
- W. H. Ah, yes. I see. So the children are quite used to working this way. You don't have any problem of getting them to, say, be quiet when you first—at the beginning of the year?
- TEACHER Oh no, no, not at all, not at all. Never any discipline problems—never any—They do it! You know, they respond to that, mind you, they like it.
- W. H. Yes.
- TEACHER And I'll tell you what I find, I mean people say that, oh if they're kept down like this all the time, you know, that they have no initiative and they're so depressed, you know...
- W. H. Mm.
- TEACHER ... but it's amazing, you see they have got initiative.
- W. H. How does it show?
- TEACHER [23] Well, I mean, it might be only little things, like, er—if I've left some books in my classroom on the desk, they always know, you see, the routine. They know that if all the books are left open—the exercise books—they're not marked. If they're all closed they know they're ready to give out.
- W. H. Yes.
- TEACHER And I've gone up there and I don't tell them to give them out, they're just left on my desk. By the time I I get up there the two boys, you know, are usually giving them out. I don't say anything, they just do it, you know. And they're all sitting there ready to start and...
- W. H. —Mm, but if you don't get there they haven't got anything to start with, or have they? Have they got a routine...
- TEACHER Oh, they'll always get on with something, always. Even if it's 'Wide Range Readers' they've got, they'll get that out and get on with that, you know. But, er,

as soon as I get up there and want to do something else, well, they immediately put their things away, they're ready to—you know, they'll always find something to do.

Again the teacher has reasons for her organization which is such that

- desks are in rows facing the front,
- the blackboard takes a central position,
- the teacher's desk is at the front of the class,
- there are no objects displayed for the children to handle.

The constraints imposed by the room and architecture of the school do not worry this teacher too much because she works in the formal way for which the building was designed. However another teacher in the same school, and teaching a parallel fourth-year group (the A stream) is less happy:

(c) *Junior teacher (2)*

N.B. The conversation is not part of the tape/filmstrip sequence. The class *looks* exactly like the class of Junior teacher (1).

W. H. I saw your desks were all in rows. Can you tell me the reason?

TEACHER It's a physical reason. Had you come yesterday you would have found them in groups again. Occasionally I go back to groups because I prefer to have a group arrangement, I find it more conducive to the sort of work I like to do, but unfortunately it's just impossible in a physical sense because, if you arrange them in groups, the chairs crash onto one another, the children can't get to the book case, the children can't get to the front. In the end I think 'my goodness! we'll put them back in rows, at least we have room to walk around.' I know what the trouble is, it's enormous great central heating pipes which go all the way round the room so that you can push nothing up to the wall. Now each piece of apparatus, table or book case or anything is about eighteen inches away from the wall. Really the rooms are shocking.

W. H. How many children have you got in there?

TEACHER Thirty-seven. Occasionally, as I say, I try groups again but it drives us all mad so we go back to rows.

W. H. But do they miss talking to each other, you know when they're in single desks?

TEACHER I guess so. Although some of our work, at least half, is the sort of work they need to get on with by them-

selves. And when it's a joint project or something they can work with a group or with a partner, then we do change the desks round if necessity demands it. For art work and craft work or big maps or big craft well we just have to change the room. But we just can't live like that all the time.

W. H. I see, yes. So you have to keep changing.

TEACHER Yes.

W. H. And the reason that the rows are facing the front, is that because you use the blackboard?

TEACHER A lot. Yes. I do.

W. H. Again, is there a particular reason for that?

TEACHER I quite enjoy the teaching situation where they watch, listen and come out and do . . .

W. H. I see.

TEACHER . . . so that a child performs to the rest of the class.

W. H. You like to keep the whole group in the activity?

TEACHER We always start off as a whole group and then, for instance in a maths lesson I start off with a new concept which I teach to the whole group, we talk about it together and so on, and do some examples together, and then we use the blackboard as a whole group. And then, as some children grasp the concept, get on by themselves with work-cards or books and so on, then the group that needs more attention from me, they will come to the front, sit in a group with me at the front and again use the blackboard. We've got no—well, not sufficient pin boarding to allow me to have a corner where I could have a visual aids corner for them to come to and work, like a flannel graph or anything like that. No, we're badly off for everything physical, except books. We've got quite a lot of books.

W. H. And a book corner?

TEACHER I've got a library area, which is a book case against a wall.

W. H. So they can't sit and read there?

TEACHER No.

W. H. They have to take them back to their desks.

TEACHER And I much prefer that when they are able to choose a book to read for pleasure that they sit in an easy situation and in a quiet place, and they can't.

W. H. Um.

TEACHER And we thought about doing this within the school, trying to find a corner in the school that we can convert into this sort of situation—but, it just isn't

- built that way. A school built in the early nineteen hundreds just wasn't equipped with these little corners.
- W. H. Do you think if you hadn't got these physical constraints you would work in groups all the time?
- TEACHER Yes. In the school I was in before—it was a brand new school and I had an enormous room with tables arranged in bays, I had a sink and attractive cupboards with display boarding which could be used to partition off corners, and it was lovely. I had a quiet corner, an art corner, a maths corner, and I worked entirely in groups there—and the day was completely integrated.
- W. H. I just wonder if you feel these children you have now are missing something—working in this way?
- TEACHER I think they are missing the chance of learning to control their own ability to learn and so on.
- W. H. Yes.
- TEACHER If you sit them in a desk and say 'this is our work', they get on with it, they do it well, they learn—very well I think, perhaps the end results are better in some respects—but they haven't got that development of their character that they have in a more relaxed situation. But on the other hand at the end of their school life they know all the rules of mathematics, they can write a sentence correctly, they can do all these formal things and I think society is beginning to realize that quite a lot of these basic learning processes have gone recently. And I think more and more it's swinging back to something formal. We want to get down and learn the rules of grammar and so on.

The architecture of the school seemed, to this teacher, to constitute an insurmountable problem. Perhaps wider changes than could be made within a single room would be needed for her to work successfully in groups.

The next sequence shows how a school with identical architecture has overcome many of the constraints imposed by the building. It involved, as we see, some breaking down of barriers, though not walls, between classrooms.

(c) *Junior teacher (3)*

(3rd and 4th years combined)

- W. H. [24] How many children have you got in your group?
- TEACHER In the group project there are about thirty-two today,

selves. And when it's a joint project or something they can work with a group or with a partner, then we do change the desks round if necessity demands it. For art work and craft work or big maps or big craft well we just have to change the room. But we just can't live like that all the time.

W. H. I see, yes. So you have to keep changing.

TEACHER Yes.

W. H. And the reason that the rows are facing the front, is that because you use the blackboard?

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TEACHER . . . so that a child performs to the rest of the class.

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(c) Junior teacher (3)

(3rd and 4th years combined)

- W. H. [24] How many children have you got in your group?
- TEACHER In the group project there are about thirty-two today,

- but some are out doing library duty and things like this.
- W. H. You said some are down the field and some in the hall.
- TEACHER Yes, there are some out in the playground because they were doing some work on, some English work involving the Wilson Road, so it was obviously much easier for them to be out in the playground doing it than sort of stuck in the classroom looking out of the window.
- W. H. [25] Now I was interested in the way you organized the room. I mean the desks were—really anybody looking would say they were all higgledy-piggledy—there was no regularity at all. Now do they stay like this or is it just because of your particular activity?
- TEACHER That's not my particular room, but my room is much the same. The upper school, on two days a week, do a co-operative project you see . . .
- W. H. Oh, I see.
- TEACHER . . . and the teacher who uses that room and, in fact, Mrs. E. and I, have our rooms arranged on that sort of basis, with the tables, and . . .
- W. H. Just for those days, or always?
- TEACHER Always, I have my classroom like that.
- W. H. Now have you ever thought about why you do it that way? That's what I'm interested in.
- TEACHER I don't know, it's difficult. I hate to see children in rows and I hate to see them regimented. [26] At the same time, you know, often I get annoyed when people think that absolute chaos reigns, because it doesn't. Every child knows exactly what they have to do.
- W. H. Yes.
- TEACHER And, it's a much more—you could say informal—but it's a much more friendly, less pressing way of working and you find the children do, you know, it's nice for them to be able to chat with a friend about what they're doing . . .
- W. H. Yes.
- TEACHER . . . or even work in twos or threes.
- W. H. You don't worry that they chat about other things rather than what they're doing?
- TEACHER [27] Oh no. I mean obviously, adults do when they work. As long as I get the end result that's sort of suited to that particular child I don't mind, you know. Obviously if a child's not achieving what he should do then I do go mad because at nine, ten and eleven they should know they've got a certain amount of work to

do and the standard one expects of them. So perhaps it's easier for us at this end of the school to say that. I know the children prefer working in this way. Obviously you get the odd one who tries it on, but, you know, you have to clamp down on that.

W. H. Do you think that they miss out on basics at all?—people say, you know, that this is not the way to get the rules of arithmetic over, and that kind of thing.

TEACHER Oh no, I think you do the other basics as a class too. For instance if a point has come up in Fletcher that perhaps two or three children find difficulty in grasping [28] then they come together and we put our pencils down and 'can someone show me such and such'—you write something on the board, but that will be about the only time I will use that. And, you know, again, things like creative writing, etcetera, that will be done as a class so that one can get the benefit of the whole class' discussion and ideas before one starts to write.

W. H. Mm.

TEACHER But you know, if for instance, you've done creative writing one day and you've noticed the children have paid not much attention to paragraphing or something then you might pick that up and explain it to them as a class. Or again, for instance, they've had difficulty in using speech marks—I took that out and explained it to them as a class. But we never go about it with the intention that 'today we're going to do speech marks and then we're all going to do...' that sort of thing. It's much more informal, but I still do things like tables with my class, but not necessarily a whole class chanting tables together.

W. H. Do they have sort of areas where they can find things for themselves?

TEACHER Oh yes, the maths things in the maths area are specifically laid out so that they all know where to get things for capacity, measuring, or money, if they want it. [29] All these sort of things.

W. H. And they get it themselves and put it back?

TEACHER Language things they don't get themselves, because there's no point in sending a child to get a language book. I'll choose a language book and a certain page in it for a particular child. Again they know where to go for their reading books, their reading area and their library, you know.

W. H. So really they're quite independent to a large extent.

- TEACHER But, again, at nine, ten and eleven they have that greater advantage.
- W. H. Er, yes, that's true. But I mean do you consciously work towards this, and do you think your organization helps?
- TEACHER [30] I think the organization does. I hate to think of children sitting—I'm not against formal education, I'm not against informal, I think one has to have a nice blend of both, there are advantages to both methods—but I think the great danger of very formal teaching is that the teacher's seen as a tin god figure. And very often the children aren't given the opportunity to think for themselves. And for an eleven-year-old—this is very often what secondary school teachers complain of, that they're too young, etcetera—and obviously if a child's got to work on his own he's going to have to develop a certain amount of self-discipline.
- W. H. [31] Yes. So you generally work like this, with different activities going on at different times?
- TEACHER Oh yes. An integrated day, yes. It's never all maths books together and then all language.
- W. H. [32] So how do you make sure there is 'a balance'?
- TEACHER Well, one literally just has to keep 'an eye', and make sure one goes round to all the children. It's like—I never take English books in to mark, I always try to grab a child, sit by the child and go through and explain. That's much more beneficial than taking a book home and just handing it back when it's done. And so, then I'll sit and ask 'how have you got on in maths today?' and such and such. I think it all depends on the relationship you've got in the class. You know, I think I have a super class, they're a marvellous bunch of kids, super sense of humour and things like this. Obviously there are one or two children who tend to skive, but knowing them well one keeps a much firmer eye on what they're doing. And I think it does all depend on knowing your class.
- W. H. Yes.
- TEACHER When I first came into teaching I had it all very formally organized simply because through lack of experience one couldn't do much else.
- W. H. And you couldn't get to know them so well then?
- TEACHER Oh, no. This is only my second year of teaching, but luckily it's the same kids.
- W. H. Is it really?

- TEACHER [33] Yes. I think it all depends on knowing your class. It's not a system I'd operate going straight into a group.
- W. H. So really you might say one reason for your organization is so that you can get to know them.
- TEACHER I think one can only do that if one does—there's no point, if you have a class, you don't, you know, you get reading ages of your class before you go to take them, but that really tells you nothing. I think it takes you three or four weeks just to get into the feel of the new class. And then one can start implementing integrated parts of the day and then going over fully to it. Having an integrated day means you can pull out the odd child for reading, or go out with a child to the library and select a reading book with them and, you know, go through a reading game with them rather than—if you all have maths books out and you're all doing maths at that time, so one daren't—I hate the idea of calling a child out to read. An integrated day means that you can get around and say 'Oh yes, let's have a look and let's read through this' you know.

Here once more it is not difficult to see that the physical arrangement reflects the teacher's ideas as to what are valuable experiences in education, i.e.

- for children to be able to talk things over with each other,
- for them to 'develop a certain amount of self-discipline',
- for them to have some of the freedoms which adults enjoy when they are working,
- to avoid the teacher taking the role of a 'tin god'.

Discussion points

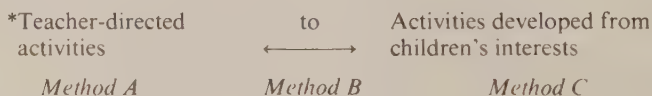
- 1 It seems clear from these examples that formal organizations are linked to formal methods. Is this inevitably so? What effect to you think the room arrangement has on the children's expectations and their ideas of the teacher's expectations?
- 2 Consider the arrangement of a particular classroom. Perhaps one member of the group will describe her arrangement to the others and answer questions about why furniture and resources are in particular places. Are the arrangements in accordance with intentions? Could different arrangements be more suited to the kind of work and goals which the teacher wishes to pursue?

- 3 What are the goals of your own organization? Could the same goals be achieved through a different arrangement? What kinds of experience are fostered by the arrangement, and what kinds are inhibited? Do the children take full advantage of the opportunities which the organization potentially provides? If not how could the reasons for this be explored?

Organization of activities

Just as for the physical arrangement the organization of activities in a particular way is decided for a purpose. Here too there is need for flexibility and room for a range of different kinds of organization. There are no 'right' or 'wrong' methods, but only ones which are more or less appropriate in different circumstances and for the achievement of different goals.

It isn't possible to consider all the varieties of methods of organizing activities, so we propose to pick three which are representative of different points on the dimension:



Method A is typically pre-planned by the teacher so that work is allocated to the children either as a whole class or to different groups or individuals. The children may work from books or cards, but what they do is characteristically decided by the teacher. There will probably, but not necessarily, be a fairly detailed class timetable which is generally followed. There is no theme linking work in one area to that in another, rather a logical order is pursued within each separate subject.

Method B links activities of different kinds to a class project or theme, lasting perhaps for a half or whole term. It is carefully planned by the teacher, introduced by her and often involves visits to related places of interest in the vicinity of the school. In the classroom there may well be a display of objects and reference materials linked with the theme and mounted by the teacher, but as the work proceeds children will add to it. Work in several subject areas will probably derive from the theme and one subject will merge into another.

Method C develops work from starting points found by the children. Almost any enthusiasm, problem or interest can be a starting point

*The suggestion of this typology of organizational methods came from Mrs. Eleanor Nisbet, Head of Valley Road Primary School, Henley-on-Thames.

from which children may devise experiments, search for information books, follow up in writing, art, craft, mathematics work. By its nature this cannot be carried out as a whole class; groups may be shifting ones, coming together when interests coincide but splitting up to pursue individual work at other times. The method is not a 'free for all', it requires organization and planning, so that the teacher can respond to children's ideas rather than direct them to activities which she has prepared for them.

Consider the advantages and disadvantages of these three methods from the point of view of

- (a) what is best for the children,
- (b) what is best for the teacher.

(a) *The children*

None of these methods would be wholly satisfactory if it were the *only* method used, and conversely all may have some part to play in helping children to achieve different kinds of goals. A balance is necessary, but can be struck only if we recognize what are the goals which a method can help to achieve, and those for which it is less satisfactory.

Take just some of the goals of education, expressed in general terms, as examples for discussing the suitability of the various methods.
e.g. Language skills (L), Attitudes and Interests (A), Moral values (MV) Social competence (S), Manipulative skills (MS), Acquisition of knowledge (K), Enquiry skills (E).

Method	Most appropriate for these goals	Least appropriate for these goals
A		
B		
C		

You might draw up a table such as this and write the initials of broad goals in one or other column for each method.

How do your ideas compare with others?

You will probably find that, if we consider goals across the whole curriculum, there is room for more than one way of organizing activities.

However, for the present we should focus the discussion on to activities in the area of science (remembering the broad definition of science on page 2.)

A suggested list of goals for 'earlier' development is given in the table below. The list is open to discussion and amendment, as proposed in Topic 2 of Theme A, 'Making and Recording Observations about Children' (pages 32 to 34), but it is probably acceptable as a basis for the present discussion.

Consider at this more detailed level, how effective each of the three methods is likely to be in providing opportunities for children to achieve these goals.

You may wish to devise some way of 'weighting' for effectiveness or just to tick the method(s) which seem(s) most effective.

If you wish to clarify the meaning of the goals then the list in the Supplementary Material, pages 181 to 183 may help.

<i>Goals</i>	<i>A</i>	<i>B</i>	<i>C</i>
Curiosity			
Originality			
Willingness to co-operate			
Perseverance			
Openmindedness			
Self-criticism			
Responsibility			
Independence			
Observing			
Problem solving			
Raising questions			
Exploring			
Finding patterns in observations			
Communicating verbally			
Communicating non-verbally			
Applying learning			
Cause and effect			
Classification			
Concept of weight			
Concept of length			
Concept of area			
Concept of volume			
Concept of time			
Concept of life cycle			

Accounts of organizational methods used by teachers for science activities are to be found in the Supplementary Material (page 227).

(b) The teacher

The method of working has to be right for the teacher as well as the children. A teacher who previously only used methods at the end of the dimension between A and B may feel very uncertain about moving in the direction of C even when she is convinced that this would be better from the children's point of view. And if she tries to move too rapidly it is likely that there will be confusion and frustration which will make her feel that she has failed, and she may decide to reverse the change.

A gradual change is necessary since the children will be used to responding in a particular way in the framework of their accustomed organization and they will not immediately take advantage of new opportunities or respond to different expectations. Also the teacher will have to be confident that she can handle the situation as changes are introduced.

A head teacher whose school has gradually moved towards a greater proportion of work in method C explains here ideas of how a gradual change can be brought about:

'If we have hitherto worked largely to a pre-planned, directed programme, then a greater use of the class project method with more emphasis on one or two individual contributions will bring added richness. A class or school, securely working within a balanced framework of methods A and B might begin to encourage some children to extend for an increasingly large proportion of time, into method C. They might be ready to introduce apparatus for children to handle in a "Discovery" corner—magnets, wires and bulbs, an old clock or radio for dismantling, living creatures or an incubator with eggs just about to hatch—and we would then assuredly find that work of quality is being done which would involve them in working through method C. This will bring about the need for the teacher to listen and observe with great care to what the children *do* really talk about and become interested in when left to themselves. It will also necessitate building up the children's awareness that we can find their contributions and ideas of value—it may also be a way in which parents and other friends can offer very real assistance and support. It will certainly involve the teacher almost at once in the need for keeping records of a different kind than those previously found necessary.'

(Mrs. Eleanor Nisbet—see page 144.)

Evidently such a change has to be planned and its success depends to a great extent upon

- the support a teacher has from the head and other colleagues,
- the materials available, for pupils and teacher (e.g. Science 5/13 units),
- the help from courses,
- the development of new skills for observing and recording children's progress. (Theme A.)

Each teacher has to go at the pace which suits her personality, experience and circumstances, and it is not possible to offer a set of procedures which will 'work' in any situation. However it is often helpful to read about how others have begun their move towards developing work more from children's interests than from their own. Some accounts are given in the Supplementary Material (page 224)

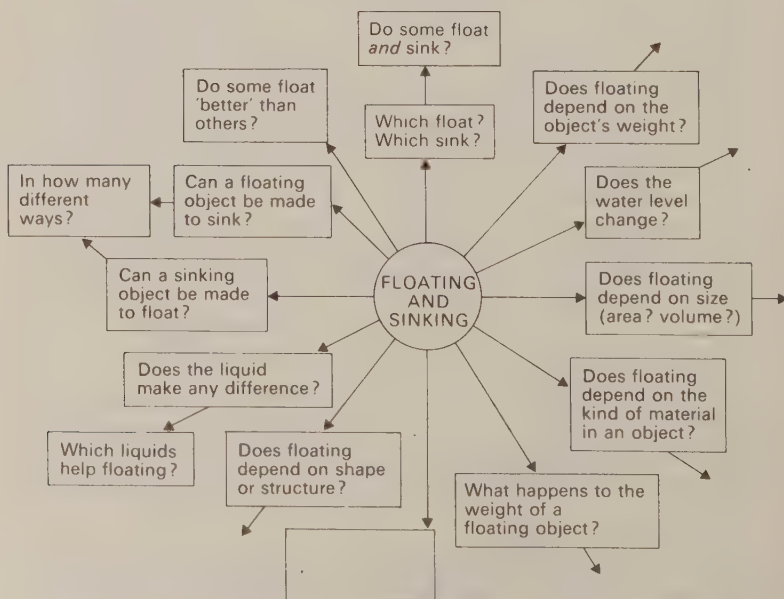
Teachers will also find the book 'Understanding Science 5/13' (Macdonald, 1977) useful in this context. In particular it gives four case studies of different ways of starting enquiry work in science.

Topic 3: Making decisions about activities

The purpose in this topic is to recognize how a particular kind of activity can help towards development of a variety of ideas and abilities at various levels.

Floating and sinking

Activities relating to floating and sinking have been chosen for detailed study because they are familiar and common in classrooms whether or not they are thought of as being 'science'. From this particular example notions of general application to other activities arise.



If at all possible it is best to have in front of you a bowl of water and a collection of objects to put in it (e.g. coins, large and small, buttons, bottle tops, small and large pieces of wood, small and large nails, plasticine, aluminium foil).

What kind of questions could be explored with these materials? Some are suggested below. Add any others which occur to you or others working with you.

Each question leads on to other questions; none of the possible trails has an end. Most of the questions should really be explored before a child can be expected to have an understanding of floating and sinking in terms of the relationship between the upthrust on a body and its weight, or between the density of an object and the density of the liquid. These are ideas which require formal thinking (discussed on pages 218 to 220 in the Supplementary Material) and not many children will understand them before the age of 12 or 13.

However floating and sinking activities are not carried out just to prepare children for understanding of what causes things to sink or float. There are many other ideas and abilities which are developed through exploring the questions which have been mentioned.

Firstly what ideas? Some suggestions, to which you may wish to add others, are

- about *weight* (e.g. bigger things are not always heavier than small things),
- about *volume* (e.g. water displaced when an object is immersed fills the amount of space taken up by the object),
- about *classifying* (e.g. some sink, some float, some do both),
- about *cause and effect* (e.g. what changes make something which floats sink?).

Secondly what abilities? Again, suggestions only:

- observation* (e.g. do some float 'better' than others?),
- raising questions*, leading to —————→ *proposing enquiries*,
- problem solving* } leading to —————→ *experimenting/investigating*,
- exploring* }
- finding patterns in observations*,
- communicating* (verbally, and non-verbally, as in using Venn diagrams),
- applying learning* (e.g. what clues can be used to predict whether a new object will sink or float?).

Relationship between the enquiries and the thinking which can be developed

The relationship between activities involved in following up the questions and the abilities and ideas which can be fostered through them is a complex one. Evidently many of the enquiries help to develop 'observation' or contribute to 'finding patterns in observations'. Conversely several ideas and abilities can be encouraged in any one activity.

To show how much interlocking there is it may be useful to try to complete a table of the kind opposite. It is not an easy task because whether or not an enquiry can help a child develop an idea depends so much on *how* the enquiry is carried out, how the child reacts to or follows up certain findings, how the teacher guides the work. Nevertheless the attempt may be worth while just because it does raise these problems and force consideration of the conditions which favour the development of various ideas.

Make some mark in the appropriate box where you think the activity would be relevant to developing an idea or ability. It may be helpful to devise some way of distinguishing between 'very' and 'quite' relevant.

Which floating and sinking activities are appropriate?

So far we have thought about the different kinds of questions which could be investigated and the ideas which could be developed through them. But what is most appropriate for particular children in particular circumstances?

To answer this we have to turn attention from the activities to the children. As a first step we can look at the video-tape entitled 'Float or sink?' It shows extracts taken from sequences where children were, at the start, giving their predictions about whether certain objects would sink or float, then testing them; later they were trying to make plasticine float.

As you watch, or read the transcript, look for evidence which suggests what ideas each of the children has about floating and sinking.

'Float or sink?' (video-tape)

Commentary

When children are putting objects in water to see whether or not they float the activity may look much the same from the infants to the twelve-year-olds, but what the children are getting from it should be different. The ideas which the children may gain from the experience depend upon the ideas they already have.

Activity	Weight	Volume	Classifying	Cause and Effect	Observation	Raising questions	Exploring	Finding patterns	Communicating	Applying Learning
Sorting: sink and float										
Investigating effect of weight, volume, material										
Making a floating object sink										
Making a sinking object float										
Investigating effect of shape										
Measuring displaced water										
Measuring weight of immersed object										
Investigating floating in different liquids										

Here, for instance, we find David and June have some unexpected ideas about the floating or sinking of these objects.

David and June are working with a plastic aquarium half-full of water and a box containing various objects. They are some way into the testing of each object to see if it floats or sinks, writing down their prediction of what will happen before they put each object in. June passes the box of objects to David, as it is his 'turn' to choose one to put in, whilst June is writing down the guesses.

JUNE What're you going to put in? The brown ball?

DAVID Wooden ball.

JUNE Wooden ball.

David starts to put it in and then pauses to make a prediction before doing so.

DAVID I'll say float.

JUNE Will float (*speaking slowly as she writes*).

DAVID Ready? What d'you say?

JUNE Float.

David puts the ball in; it sinks first and rises slowly to the surface.)

JUNE Right.

DAVID Just floats.

JUNE Tick it.

She passes the paper to David, as they agreed that one writes and the other ticks it if the guess was correct.

JUNE My go.

David takes the paper and pencil and June takes the box of objects.

DAVID What is it you're going to get?

JUNE Bracelet (*she chooses a plastic bracelet*).

DAVID Bracelet (*writing it down*). Will what?

JUNE Sink. It's light, it'll sink. (*She holds it above the water, weighing it in her hand.*) It'll sink. Sure it will. I say it'll sink.

DAVID I don't (*laughing a little whilst he writes*).

JUNE Sink . . . (*indistinct mumbling*)

DAVID Go on.

JUNE What do you say?

David seems not to want to answer and June puts the bracelet in before he has a chance to. It sinks.

DAVID Oh—ah.

David takes the box again and June the paper. David picks out a small rubber ball.

DAVID Rubber ball.

JUNE Rubber ball?

DAVID Yea, rubber.

JUNE Rubber ball (*writing it down*).

DAVID You should put a dot—after it.

JUNE No!

DAVID O.K. Just—

JUNE Will what? Float.

DAVID Float. (*Places it on the surface of the water, where it stays, floating.*) Float.

June ticks the paper, then seems to remember that she shouldn't have done it.

JUNE Oh, I ticked it. An—

DAVID I don't mind if you do tick it.

David takes the paper, after wiping his hands on his shirt. June takes the box and selects a piece of plasticine as her object.

JUNE Plasticine.

DAVID Oh, you got the best one. I was gonna have that next. Plasticine will sink (*writing*). What do you say?

JUNE Will sink. No, float, no, sink. Don't matter which.

DAVID Go on.

Commentary

June and David seem to take notice of the weight and materials of the objects, ignoring other variables. In a similar situation Andrew and Mark have identified objects which can float or sink under different conditions and are investigating possible reasons.

Andrew and Mark have tested out all the objects, recording their guesses and their findings for each. The teacher is discussing the results with them.

TEACHER I see. Now of all those objects that you've just tested are there any that will sink and float?

MARK Yes.

ANDREW Yes. (*He selects two objects from the box to show.*) Those two.

MARK The shell.

ANDREW The shell—and there's one more thing, that...

He has picked out the shell and two bottle tops and places them on the water so that they float.

ANDREW They float that way.

MARK —put in that way.

TEACHER Yes.

Mark now adds another object, a small plastic counter which can be supported by surface tension if placed carefully, which he does.

MARK Look, if that one's placed in, it floats.

TEACHER It floats, yes.

ANDREW If they're dropped in, they usually sink. (*He takes them out and drops them in.*)

MARK Oops, wait a minute. (*He tries again with one which didn't sink. The counter lands in one of the bottle tops which hasn't sunk.*)

ANDREW Good shot (*laughing*).

TEACHER Does it make any difference which way up—

ANDREW Yes.

MARK Yes.

TEACHER —you drop it from the top?

MARK It goes—just sinks.

Andrew takes out a bottle top and holds it open end downwards.

ANDREW If you, see, if you put it in this way.

MARK The air'll stay in—

ANDREW The air'll . . . turns over.

The top flips over and floats open side upwards. He takes it out and tries again. This time it sinks.

MARK It sinks.

ANDREW Sinks.

TEACHER It sinks. If you lay it on can you get it to float?

ANDREW Yes.

MARK Yes, just lay it on.

Mark lays them on the surface but open side upwards. They float.

ANDREW What about the other way up?

Mark tries placing the tops on the surface open side downwards. They sink.

MARK No.

ANDREW (*indistinct*) can . . .

MARK The shell. (*He tries to float the shell, but it sinks when placed on.*)

ANDREW Have another go.

MARK Shell won't.

ANDREW If it gets full up with water it sinks.

Mark empties the water out of the shell. Puts it back on the surface. It floats.

MARK That way up will . . .

He takes it out and places it in with the open side downwards. It turns over and floats.

ANDREW Aha. Success.

MARK (?) floats.

ANDREW That was because the air all came out in a bubble.

MARK Yea.

TEACHER What about the tops?

ANDREW See, just try.

Mark drops them in open side upwards and they float.

ANDREW Try them the other way up again.

Mark drops them in open side downwards. They sink.

MARK They just turn over and sink.

ANDREW Wonder why?

TEACHER So you can't get them to float at all?

MARK Unless they're . . .

ANDREW Unless they're that way up, like that.

MARK . . . pushed in

TEACHER Oh, I see.

Commentary

Although David and June also noticed that the bottle top would float or sink they do not make use of the clue which this could have given them when a little later they tackle the problem of making plasticine float.

June and David are putting pieces of plasticine in the water, with no success at making them float.

DAVID It sinks! Can't make it float.

JUNE I can, you know.

June turns towards the teacher who is approaching.

JUNE No, it just, just sinks.

DAVID Wait a minute, I got an idea.

JUNE Perhaps if we made it smaller . . .

DAVID O.K.

TEACHER It just sinks. Well perhaps you've got to mould it in a different way.

JUNE (*interrupting*) Make it smaller.

DAVID I did, I moulded it into a thing like a ship . . .

JUNE Wait a minute.

DAVID . . . a ship—didn't I?

He places the piece he has been moulding in the water and it sinks.

DAVID . . . there you see?

TEACHER Keep trying. (*She leaves*).

DAVID (*mumbling*) squelchy.

They are both pressing their lumps of wet plasticine together, then David breaks a piece off his.

JUNE . . . squelchy welchy, squelchy welchy (*to herself as she works*).

She takes a piece off her lump.

JUNE D'you want a bit? Of this?

She gives him a bit without waiting for an answer.

DAVID I've got an idea...

He has been flattening his piece and now tries it in the water.

JUNE I'm making a ship.

DAVID (*Laughing, as it sinks*) Sinks!

JUNE Sinks, does it?

DAVID D'you call that a ship?

JUNE There, it's got two seats and a sail.

June puts her ship in the water whilst David is still trying his.

DAVID (*Laughing*) That'll sink. The weight, extra weight. Wait a minute. I've got an idea. Keep...

June's 'ship' is a solid model, there is no attempt to scoop out a hollow inside it.

David is trying a piece of plasticine in the water. After it sinks he brings it out and reaches for the wooden ball from the box of objects.

DAVID I think I know.

He starts to press the plasticine round the wooden ball, humming to himself as he works.

JUNE Mind, out the way!

June puts her boat on the water. It sinks. David also puts his ball covered with plasticine in. It sinks.

DAVID That sank—it didn't work...

JUNE Mind out the way! (*She tries hers in the other way up.*)

DAVID It won't go.

Commentary

The model ship which June created had seats and a sail, but it was solid; probably she did not appreciate the aspects of the shape which were relevant to giving buoyancy. David did try to make a hollow boat, but gave up when it sank and then tried to use the wooden ball to buoy up the plasticine, an approach which could have worked with a larger ball and smaller piece of plasticine.

By contrast Mark and Andrew seem much more sure of how to tackle this problem, and soon work out a successful approach.

At first they are trying bottle tops, one way up and then the other. The teacher is watching them.

ANDREW ... the other way.

TEACHER Now then, what about the plasticine?

ANDREW Sinks.

MARK Sinks.

ANDREW ... mess (?)

MARK ... if you mould it.

Let's try, see if I can do it. It's wet.

TEACHER Now, see if you can get it to float. (*She leaves them.*)

Mark is busy working the plasticine while Andrew watches.

ANDREW Boat shape.

MARK No.

ANDREW Make it so that it traps air.

MARK What the ...

ANDREW Inside.

MARK You do it your way, then. I'll do it mine.

ANDREW That's it, make it into a boat. Oh, like that, I see.

The teacher is handing Andrew another piece of plasticine.

TEACHER Perhaps just take off a little bit. (*She leaves.*)

ANDREW Hm (*nodding*)

Both are moulding busily on their separate models, patching the sides where they become thin. They only whisper quietly to themselves.

ANDREW Got to dry me hands.

(*To himself*) Getting all flimsy now.

He adds pieces to strengthen it. Andrew places his on the water and it floats. Mark puts his on.

MARK ... it floats.

ANDREW There we are.

Mark picks up a marble to use as a weight in his boat. He puts it in and the boat sinks.

MARK It only just sunk, though, didn't it?

Discussion

1 What are the present ideas of these children?

Although our evidence is not very certain we can make some tentative inferences about their ideas.

- e.g. June: Seems to be confused about the effect of weight ('It's light, it'll sink'), had no idea of how to change the shape of the plasticine to make it float (made a solid boat shape).
- David: Possibly had a better idea of what was needed to make the plasticine float (used an object which he knew floated to buoy it up, and also made a hollow shape).
- Andrew: Realized that replacing water by air would help the shell to float ('If it gets full up with water it sinks'), didn't see immediately how to apply this to make the plasticine float (watched Mark and then copied what he did).
- Mark: Had a clear idea of how to make the plasticine float ('Make it so that it traps air').

Here the inferences drawn about the children's ideas are based upon the evidence which is given in brackets. It is important not to confuse inference, or judgements, with observations, otherwise we might be in danger of making decisions on vague general impressions and not on the basis of real evidence. So as you add other observations about the children, make sure, if you are making an inference about their ability of one kind or another, that you give the evidence to support it.

- 2 What are appropriate further activities for these four children?
Discuss the following suggestions and modify them as you think best.
- June: more experience of putting objects of varying weight, size and material in water.
- David: further exploration of objects which can be made to float or sink.
- Andrew: finding more ways of making a sinking object float.
- Mark: might go on to investigate the water displaced when the plasticine floats and when it sinks.

- 3 What other factors should be taken into account?

We are *not* suggesting that the children are *directed* to these kinds of activities, but rather when the opportunity arises these are the sorts of things they could profitably explore, possibly as part of some other investigation. The 'opportunity' depends on several things—their interest, the satisfaction they may derive, as well as whether suitable materials are available. Perhaps you can add other factors.

The teacher's role in deciding how to guide them to their next step is evidently an important one, which is taken up in Topic 5. In the next topic we go a little further into the adaptation of activities to suit different levels of mental development.

You may find it useful to read pages 213 to 220 at this point if you have time and have not already done so.

Topic 4: Adapting to levels of thinking

The purpose here is to develop a way of analyzing activities so that their suitability for individual pupils can be examined and they can be adapted to avoid mismatching.

We are concerned here with the variations in activities which can be provided to suit children at different points in development of various ideas and abilities. Two important reservations about what can be done in this matter have to be kept in mind:

- 1 There are no formulae which can be applied to matching experiences to developmental level, no sequences of activities which are 'right' for every child, therefore the discussion is best focused upon how we can make decisions about what seems best in individual cases. The guide-lines which can be offered might be better thought of as ways of preventing mismatching rather than guide-lines for matching.
- 2 There are many factors other than intellectual level to be taken into account in making decisions about children's activities; it must not be thought that they are considered less important because they do not feature as prominently in this discussion. Consideration of factors such as the child's interests and attitudes, the social context of his learning have also to be taken into account in deciding the organization and approach which will minimize mismatching.

General features of activities appropriate at different stages

In Theme B, 'Children's Development and Learning' the changes and development in children's ways of thinking are discussed, and some general points about activities suitable at different stages are proposed (page 92). These general ideas emerged from the study of how children make sense of their experiences as their ideas and mental abilities change and become more powerful. The principle guiding the selection of activities on page 92 is that the level of new experiences should be such that they can be understood by the child with his existing ideas, but that they should also provide some challenge to these ideas so that some opportunity for extension and development is provided. (This is elaborated in the discussion of matching in theory and in practice in topics 5 and 6 of 'Children's Development and Learning'. (pages 106 to 123.)

Becoming more specific

At the more specific level of particular activities we can apply the same principle, as used for the more general points, for considering how appropriate are the activities for a certain child or group of children.

Questions to ask about a child and an activity to explore the likelihood of a match or mismatch are:

- 1 Does the child have the ideas and abilities which are necessary prerequisites for tackling the activity?
- 2 Does the activity provide opportunity for the child to develop existing ideas further, without demanding too large a change in ways of thinking?
- 3 Are the experiences available to the child in a form which is suitable for him?
- 4 Are the organization, social grouping and other conditions of working, suitable?
- 5 What approach by the teacher will be of most help to him?

Questions 1 and 2 are the main concern of this topic. (Question 3 is discussed in the general considerations on page 92, question 4 has been already discussed (p. 144) and question 5 will enter into topics 5 and 6 of this Theme.)

To answer the first two questions it is necessary to look at the activity in relation to the ideas the children may have.

What ideas have to be already
formed for the activity to be
tackled? }

Do the children already have these
ideas?

What ideas can be developed
through the activity?

Do the children already have these
ideas? If not, are they likely to be
able to extend their thinking towards
them?

We propose to apply these questions to activities connected with formation of ideas about weight.

Weight

Some *ideas and abilities* which a child may have concerning weight:

- A Able to use words 'more', 'less', 'same', 'a lot', 'not much'.
- B Able to use words 'heavy', 'heavier', 'light', 'lighter', 'weight'.
- C Recognizes that weight is felt and not judged by appearance.
- D Conserves weight when changes alter appearance without altering the weight effectively.
- E Appreciates that if A balances B and B balances C then A balances C.
- F Able to use standard units when measuring and estimating weight.
- G Appreciates weight as a measure of pull downwards by the earth.
- H Distinguishes between mass and weight.
- I
- J

Some quite common *activities* (the order in which they are written is random):

	<i>Prerequisites</i>	<i>Development</i>
Comparing weights of objects and ordering them, without using a balance, when some of the objects are larger but lighter than others.		
Lifting a heavier object with the force of a lighter one.		
Balancing an object against conkers, marbles, etc. 'How many cotton reels balance this box?'		
Investigating changes in weight when there is a change in volume. (e.g. rising bread, heating popcorn.)		
Devising a balance to 'weigh' the teacher, and another to 'weigh' a grain of rice. (More strictly, finding a mass which exerts a force equal to the force exerted by the mass of the teacher or grain of rice.)		
Measuring and estimating weights in standard units.		
Discussing space travel, 'weightlessness' etc.		
Play with sand, water, pebbles, etc. discussing the effect of adding more, taking some away.		

Turn to the first of the activities suggested above, i.e.

Comparing weights of objects and ordering them, without using a balance, when some of the objects are larger but lighter than others.

What are the prerequisite ideas or abilities needed for tackling this activity? Consider the ones in the list and note those (use the letters to label them) which you feel are required under 'Prerequisites'. If you think important ones are missing from the list suggested, then add them in the spaces left.

What abilities and ideas can be developed through the activity? Again indicate by their letters the ones which go under 'Development'.

Application to 'avoiding mismatching'

In the case of the 'weight' activities a 'match' is most likely (though by no means certain—remember that we are only considering the intellectual aspects and not the other factors which have an influence) when a child has the 'prerequisite' ideas but not those under 'development'.

We can say with rather more confidence that a *mismatch* is quite likely when either

- the child has not the 'prerequisites'
- or —he has both the 'prerequisites' *and* the ideas under 'development'.

In these cases the activity is either too advanced or too simple for him. In such circumstances the activity is not necessarily without value, but it is unlikely that his ideas about weight will develop.

How to avoid mismatching?

Firstly by finding out the children's present ideas and abilities.

Secondly by selecting activities so as to avoid those which are mismatched, according to the consideration of prerequisites and development potential.

Thirdly by adapting activities to reduce the chance of mismatch. Each of these deserves further consideration.

The children's ideas and abilities

The whole of Theme A, 'Making and Recording Observations about Children' is devoted to this subject, but in summary we suggest that this is best done through observing the children's reactions and responses in their work. We can do this because the children show in their behaviour the way they think and feel about the things around them. To pick up and use this information it is necessary to know what to look for and how to interpret what is seen in terms of developing ideas, abilities or attitudes. The *check-lists* are provided as a way of helping to gather and interpret information about the children.

However the check-list statements provide only a brief summary of behaviour relating to various stages of development of each aspect. A rather more detailed description is needed as a guide for making decisions about particular activities. Part of the purpose of *Finding Answers* is to provide this fuller picture of the change in ideas, abilities and attitudes as children grow.

After describing the changing ideas and abilities in terms of the behaviours by which they are made evident, as in the case of ideas about weight which we have considered, it is possible to find out about the children's development by observing whether or not they show these kinds of behaviour. It is not necessary for the children to be working on particular problems for their ideas to show. For instance it is not

necessary to be 'doing' area for ideas about area to be noticed, as is shown in the following observation by an infants' teacher:

'We go up to the hall to use the apparatus. I decide to alter its arrangement and ask the class to go and wait on one of the P.E. mats out of the way. The boys throw themselves in their usual heap, and there's a chorus of "we can't all get on one mat". "Are you sure?" The children start finding out how they need to pack themselves together to get as many as possible on. Some said they should make themselves as near as possible into a round shape . . . This chance happening in the hall led naturally into work in class on covering surfaces, and shapes which fit and those which don't.'

The development of the *concepts* included in the check-list for Earlier Development is outlined on pages 72 to 124 of *Finding Answers*. Similarly development of various abilities and enquiry skills is outlined on pages 125 to 169.

Selecting activities to avoid mismatching

By analyzing activities in terms of prerequisites and potential for development it is possible to derive some indication of which are more suitable when children are at particular points in development. However as this analysis takes into account only *one* aspect from the many which affect matching we must be very tentative about the result. It is, as we have suggested, wiser to consider this as a guide to avoiding mismatching, for we can never be sure that an activity will be a match.

This approach has been used to indicate activities which seem appropriate at certain points in development, somewhat in the way we have worked out for weight, for other concepts and abilities. The results are set down in *Finding Answers* in the following pattern:

<i>Ideas and abilities</i>	<i>Appropriate activities</i>
A	a, b
B	a, b, d
C	c, a, b
D	a, b, d, e
E	a, b, e, f
F	f
	
	

Upper case letters represent ideas and abilities and lower case ones are the kinds of activity. The most useful way of interpreting this outline is:

- a child who has ideas B (actually A and B since these are cumulative)
- may benefit from activities a, b and d,
- is *unlikely* to benefit from c, e, f, etc.

Thus a, b and d could be provided (though these may not turn out to be suitable for other reasons) but it cannot be expected that the child can tackle c, e, f, etc.

Adapting activities to avoid mismatching

In many cases it may not be possible, or desirable, to avoid activities altogether, as, for example, when a mixed ability group work together and there is benefit of social interaction. The children may not be able to benefit intellectually from doing the same thing, but the work of each one can be adapted to his development whilst they are all still engaged with the same material and work in co-operation.

The adaptation can be based on the same method of analysis of demand of the activity which we have carried out.

i.e. If a child does not have the prerequisite ideas and abilities can the material be used or supplemented in a way which will enable him to develop these?

If the child already grasps the ideas which are required for the activity what differences would enable enquiries to be carried out which develop further ideas?

We have already considered the range of activities which arise from floating and sinking. You may like to try working out, on your own or with others ways of adapting other activities so as to develop ideas at different levels. Choose one of your own, or, 'counting heart beats before and after exercise'

Topic 5: The teacher's role in supporting progress

The purpose here is to identify the kinds of teacher behaviour which are most likely to facilitate matching and to lead to helpful teacher interventions.

In the last topic it was proposed that matching activities to children, or more practically, avoiding mismatching, involves

- finding out about the children's ideas,
- selecting or adapting activities to avoid ones which make too little or too great a demand on the children.

These have important consequences for a teacher's role, which we now examine. But first some points which acknowledge that things are not as simple as these statements may seem to imply.

(a) Finding out about children means in this context finding out about a range of ideas, attitudes, abilities and so on. For each aspect the information needed is about where the children are in development, and this implies *knowing what the likely course of development is*.

(b) A teacher cannot expect to gather on the spot all the information needed about a child to make the best decision at any time. Therefore it is necessary *to work in a way in which this information is constantly picked up and added to*.

(c) Decisions about the kinds of activities which are suitable are not the only ones teachers have to make, and we should widen the range of decisions considered to include those about *adapting the learning environment* (see pages 124 to 127).

(d) Some decisions are made in situations where there is little time for cool reflection. They have to be made instantly, often with hardly any time for thought. It is for this reason that we refer to these activities as part of the teacher's role for they have to be *almost automatic ways of responding* to situations *where a decision has to be made*.

(e) Other decisions, of course, involved in longer term planning, can be made as a result of more careful study of information about the children and analysis of demands of various activities. This preparation does not take the place of moment-to-moment decisions but a carefully prepared environment gives more opportunity for children to choose suitable activities and so reduces the dependence of the children on the teacher.

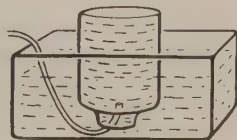
Analyzing interventions

The most useful way to describe the teacher's role is in terms of behaviour—what she does or says. At this point we are focusing on how she responds in everyday situations where she is intending to help children progress, rather than on her role in making decisions about organization and planning.

We first try to identify what she does.

Put yourself in the position of the teachers in these examples and consider exactly what she would do, and say, and what might result in terms of the children's activity. Write down your list of teacher behaviour. Identify the *details* of how the teacher decides what course of action to take, not just whether she decides to do one thing or another.

1 The teacher has a class of eleven-year-olds. At this time they are working on a variety of topics, some finishing maths, others using the library corner, etc. One group is at the sink where a large aquarium has been filled with water and they have set up a simple arrangement for comparing the amount of air which they can blow out of their lungs in one breath. It was their suggestion to do this and they obtained the large plastic toffee jar to do it, after finding all the containers in the classroom were too small. The teacher discusses with them what they are going to do, sees them take one or two measurements and then leaves. She is engrossed



with other groups for some time, and when she returns she finds the children have stood the toffee jar upright, full of water and are syphoning water from it into the aquarium.

What does she do?

- 2 A teacher of nine and ten-year-olds has planned to take the children to look at the local church and churchyard. She has made the usual preparations, discussing with them what they might look for and making sure they are taking a pencil and notebook. They set out at the beginning of the afternoon. The route to the church takes them past a terrace of old houses which have just been restored. The children notice that all the doors have iron door knockers, beautifully cast. Some ask the teacher if they can stop to look more closely at them—are they all the same or different? Are they very old? Do the patterns mean anything? How do you make metal into shapes like that? Can we draw them? Why are some rusty and not others? There is lots of interest and enthusiasm for the knockers, but if they stop here there won't be time for the church.

What does she do?

- 3 A group of eight-year-olds has been testing objects with a magnet. They have collected quite a few things from around the classroom and put them into two groups, attracted and not attracted by the magnet. When the teacher comes to see how they are progressing she finds that some heavy steel objects, including the stapler from her desk, have been put in the 'not attracted' group.

What does she do?

Of course there are no 'right' courses of action in any of these situations, but they present the teacher with the obligation of deciding to *do* something.

Discuss your descriptions of her actions with others.

Are there any patterns in the teacher's actions described in your own three accounts?

Are there any patterns among the group's accounts?

What does the teacher *do first* in most cases?

What kind of things would she say first?

If you are studying alone and have no one else's ideas to compare with your own you may find it useful to read the discussion on pages 220 to 224 in the Supplementary Material, where a group talks about the first situation.

What differences are there in responses? What are the advantages and disadvantages of different courses of action?

If you are able to arrive at a list of the sorts of behaviour which you think characterize good decisions, list them with your reasons. Then keep them in mind whilst you watch the video-tape 'Teacher Interventions'.

Teacher interventions (video-tape)

Commentary

The teacher is a key figure in the environment in which children learn. She sets up the situations in which they choose or devise their activities and she is the major source of guidance. Some of this guidance takes the form of an intervention in the children's activity. At one moment they are working by themselves then the teacher comes up intending to help them—but is she always a help? What makes for a constructive intervention? Why do some interventions have the opposite effect from that intended?

We shall see four brief extracts showing teacher interventions, all made during the normal course of events and intended to be helpful.

In this first sequence the teacher comes in at a time when she sees that the children are having difficulty. She explores their problem with them, and in doing so finds the way to help them.

Deidre and Allyson have been working for some time on the problem of building a bridge with spills between three supports, which are further away from each other than the length of the spills.

TEACHER (*Enters and addresses the girls, but words not audible*)

ALLYSON Not very well.

TEACHER Not very well. What have you been trying to do?

ALLYSON Trying to get some support at the bottom to hold it up.

DIEDRE (*At the same time*) Well, that, that's . . .

ALLYSON We tried weaving but it didn't work very well.

TEACHER It didn't work? Why didn't that work?

ALLYSON I don't know. Just wouldn't stay there.

TEACHER Can you show me how you were trying to weave it?

Allyson takes four spills and lays them across each other to form the start of a woven mat. Deidre is doing something similar but resting hers on one of the supports.



DIEDRE That's what I do. I get two like that. Two together.
(Pause) Pulls towards that one and one across there.

She is showing how her weaving provides a bridge from one support to another.



TEACHER Yes.

DEIDRE That's how I did it on that one, but...

ALLYSON Sorry.

Allyson just tips Deidre's spill. Allyson has now three spills in each direction.

TEACHER So, does that make it stronger?

ALLYSON No, not very.

TEACHER It doesn't? (*Pause*) You don't make, think it's stronger...

ALLYSON (*Interrupting, as if a thought suddenly strikes her.*) We could weave... Oh, no we can't we haven't got enough sticks.

TEACHER If you need any more I can give you some more.

ALLYSON Can you?

DEIDRE We're thinking of weaving...

ALLYSON We could weave it all.

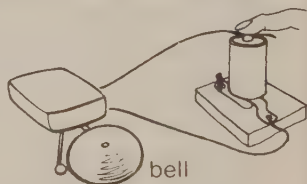
TEACHER All right! Try and weave it all.

ALLYSON Can we have some more sticks then?

Commentary

In the next sequence Martin and Andrew are also finding difficulty with another problem, of making the bell work using a switch in the circuit. In this case the intervention of the teacher isn't quite so helpful.

Martin and Andrew are working with some batteries, wire and an electric bell, which they have managed to ring. The teacher comes up to them and 'tidies' some things aside before speaking to them. Their arrangement is shown opposite. The battery is held on to one side of the switch and the wire pressed on to the top of the battery.



TEACHER Yes, but you're not using the switch are you?

Bell continues ringing.

ANDREW No.

TEACHER You're just touching the wires on. I want you to be able to make it work just by pressing that, not by pressing the wires. (*They still continue to make the bell ring.*) Take it off a minute. Now I want you to be able to make it work not by touching the wire on but by pressing the switch.

ALLYSON Like this?

TEACHER Can you put that wire anywhere else, so it doesn't get in your way? (*The boys fumble, holding wires on the contacts*

of the switch.) This one, that you're pressing here. Can you tuck it out of the way somewhere else so you don't have to push it down?

MARTIN Under there. (*Martin has pricked his finger on the end of the wire.*) Gives you a shock, doesn't it?

ALLYSON Where's the other wire?

Bell is ringing, neither boy touching the arrangement which is neater than before. But the battery is still balanced directly on the side of the switch to which the wire from the bell goes, with the other wire held to the top of the battery.

MARTIN Look, we can get it to go without touching that.

TEACHER But are you using the switch?

MARTIN No, we're not pressing that.

TEACHER I want you—you know how when somebody comes to the door and they have to press the button, don't they?

MARTIN Yes.

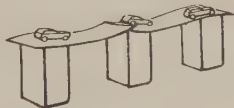
TEACHER I want you to be able to work it by just pressing that, not by touching the wire on, that's cheating.

She places her finger on the switch as she says 'that'. The boys carry on along the same lines as before.

Commentary

Sometimes teachers try to be too helpful, giving large hints to the solution of a problem or feeding the answers to the children. But how helpful is this really?

Michelle and Duncan are working on the problem of building a bridge from paper to span two bricks and to be strong enough to carry some toy cars. At this point they have introduced a third brick in the middle and their structure looks like this:



Michelle has been explaining to the teacher that the bridge is starting to fall down.

TEACHER What makes it start falling down, then?

MICHELLE 'cos there's...

DUNCAN Too many cars.

TEACHER There's too many cars. Right, well, let's take the cars off again (*they immediately do this, so she pauses*) and think about this paper. Now the paper is not very (*pause*) strong.

MICHELLE Strong.

DUNCAN No.

TEACHER Now is there something you could do to the paper to make it stronger?

DUNCAN Change it.

Michelle smiles at this.

TEACHER Apart from changing it. You want to use this paper.

DUNCAN Um. (Pause) Stick it together, put something heavy on it.

The children look at each other blankly.

TEACHER What else could you do to it? Something very . . . simple, that you could do to it just now?

DUNCAN Paint it.

TEACHER Paint it?

DUNCAN Yes.

TEACHER Will that make it stronger?

MICHELLE Well, the paint makes it thick.

DUNCAN A little bit.

TEACHER The paint makes it thick.

MICHELLE If we had thick paint . . .

DUNCAN Thick paint

MICHELLE . . . and we just put water all over it and then put powder paint on it, and we put it on there it'll be a bit thicker.

Michelle demonstrates what she means and then places the paper on top of the bricks.

TEACHER Do you think it'll make it stronger?

Duncan takes a car and runs it along the paper making it sag.

DUNCAN Yes, but if it's one sheet it'll just go down.

TEACHER It will still go down, won't it?

MICHELLE One sheet.

TEACHER That isn't quite the answer. Can you think of anything else you can do with it?

DUNCAN Er . . .

Both children have their faces supported on their hands, in thought. There is a pause.

TEACHER Can you think of packing cases, and boxes. (Pause) What do they use inside the boxes?

DUNCAN Lining.

TEACHER Yes, do you know what . . .

DUNCAN Material.

TEACHER . . . what is the lining like . . .

MICHELLE Soft?

TEACHER . . . often?

- DUNCAN Um, soft.
 MICHELLE Sort of soft, stuck on.
 TEACHER Yes, soft, yes, but what about the card?
 MICHELLE It's quite hard.
 DUNCAN Oh, we could—um. (*Sudden thought quickly peters out.*)
 TEACHER What is it made of?
 DUNCAN Cardboard?
 TEACHER Well, it's (*indiscernible*) it's cardboard? But the cardboard's in a special way. Do you know how?
 DUNCAN No
 MICHELLE (*Shakes her head.*)
 TEACHER Have you not seen paper which is curved and crinkled? (*She makes signs in the air $\sim\sim\sim$ with her finger.*)
 DUNCAN Corrugated paper.
 TEACHER Corrugated paper, right! Now that is something firm.
 DUNCAN Yea.
 TEACHER Could you do something like that with the paper that you have here?

Both look uncertain. There is a pause.

DUNCAN What, make it all curved?

They both pick up pieces of paper and start to fold them.

DUNCAN —come on, quick—

Commentary

Interventions are not only made to sort out problems, however, but often just to check that things are going on all right. But what happens if the children think everything is satisfactory but the teacher has different ideas? Martin and Simon have finished what they were doing with the tockers and start their own investigation with the timers:

Martin and Simon are at a table with three timers and three tockers. They are counting the tocks of each tocker.



- MARTIN } (*Together*) . . . thirteen, fourteen, fifteen, sixteen, seven-
 SIMON } teen, eighteen, nineteen, twenty.
 MARTIN Yea, twenty.

They put all the tockers together and reach for the timers.

- SIMON Shall I give you a sand timer race?
 MARTIN Mm. Shall I give you a sand race with one of those?

Simon has one timer and Martin has hold of two.

SIMON We only have one each. I'm going to have the green. Do you want the salt?

MARTIN No. I'm not having the salt.

Without saying anything they prepare to turn their timers over at the same moment.

MARTIN Go.

SIMON Go.

They turn their timers over—one each and then stoop down so that the timers are at eye level, studying them intently.

SIMON Mine's winning, mine's winning.

MARTIN No, it isn't.

SIMON 'Tis.

MARTIN It won't be in a minute.

He starts to tap the top of the timer quite vigorously, and then Martin does the same.

SIMON Shsh (*imitating noise of sand streaming down*).

MARTIN First person to get all of it down.

Pause while they watch their timers with absorption.

SIMON I got more down than you.

MARTIN Look all down. All the stuff at the top down. (*Martin picks up the third timer.*) Oh yes, and look, I can use this one too 'cos I got . . .

SIMON Yes, 'cos I got the longest one.

Martin turns over the third timer.

MARTIN Yea, this one's (*indistinct*).

Simon reaches and turns the third timer again, pointing to it as he says.

SIMON No, you do this one after that one's finished.

MARTIN Yea.

They return to careful study of the sand streaming down, saying nothing. Pause. Then the teacher returns quickly, sweeping the timers to the side and bringing the tockers in front of the children again.

TEACHER Did you manage to do your counting?

MARTIN Yes.

SIMON Yes.

TEACHER And how far could you count when you did that one?

MARTIN } (*together*) Twenty.

SIMON }

- TEACHER Could you? And you could fit them all in?
MARTIN Yes.
SIMON Um.
TEACHER Did you go a bit faster ...
-

Discussion

It tends to distort the discussion if we make judgements on the teachers in the video-tape and typify them as 'good' or 'poor'. All teachers at some time or other intervene in children's activities in a way which is less than helpful. So it is best to discuss these examples as instances of teacher behaviour which are commonly found in classrooms and might all be observed in a busy teacher's daily behaviour.

For each extract two things could be considered:

- 1 What did the teacher find out about the children as a result of the exchange?
- 2 In what respects was the children's progress helped by the exchange?

Summary—the teacher's role in supporting progress

Bringing together the various strands in the discussion we see that a teacher is in the best position to extend a child's thinking if she knows

- (a) where he is,
- (b) what is the appropriate next step for him to take in the development of his ideas,
- (c) what activities or approaches may help him to take the next step.

These were the three elements which were included in the outline of the matching process given on page 6. It was stressed there and discussed in more detail in 'Matching in Theory' (pages 106 to 116) that gathering feedback is essential to helping children make progress. A summary of the points about matching is relevant here for they give strength and added meaning to the points made about teacher's interventions and decision making.

Firstly recall that 'matching' means providing children with experiences which they can understand with their present ideas but which also extend and develop these ideas.

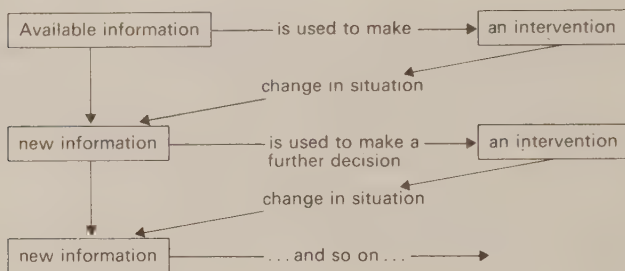
Then we have to acknowledge that

- (a) we do not know exactly what experiences will be the best even if we knew everything about the children's ideas, which of course is not the case,
- (b) we can only give general guidelines for selecting suitable activities

and approaches, leaving the 'fine tuning' to the teacher on the spot,

- (c) with rather more certainty we can say what activities and approaches are likely to be mismatches. This is not as negative as it may seem at first.

Matching to the unique characteristics and abilities of an individual child can be approached through a strategy in which



Each time a decision is made it changes the situation and the change (whether an improvement or otherwise) provides new information to add to what is already known. The strategy for matching is a repeated process of this kind, in which each decision is the best approximation to 'matching' at that time, but its effect provides information which will enable the next decision to be a closer approximation.

As preparation for the next topic it would be worth while to read pages 66 to 69 if you have not already done so.

Topic 6: The teacher's role in developing positive attitudes and personal characteristics

The purpose here is to identify and discuss types of teacher behaviour which may encourage or discourage development of positive attitudes.

The wholeness of learning

In the last topic the concern was mainly with the teacher's role in making decisions about providing experiences which help children's intellectual development and growth of knowledge. Whilst doing this she is also affecting other kinds of development, of attitudes, self-concept, interest and motivation. We acknowledge that these two main aspects of development relating to the intellect and to feelings—

cannot be separated in practice, for they are both involved in any learning situation, and by treating them separately we are not implying that a teacher can be concerned only with the intellectual side of children's development at one time, or only with feelings at another.

The meaning of 'attitudes' and the importance for learning of positive attitudes towards oneself are the subject of Topic 2 in Theme B, 'Children's Development and Learning'. It is probably worth while here to summarize some of the points made, and add others, which emphasize the interrelation of thinking and feeling.

- 1 Repeated experience of failing to reach the expectations others have of him is likely to result in a child feeling that he is 'no good', which makes him prepare for and anticipate further failure. Thus he not only reinforces his feeling of being 'no good', but also misses opportunities for developing intellectual abilities.
- 2 Immature attitudes towards learning, as shown in children's tendency to blame their failure on others and regard their behaviour as being externally controlled, are more typical of children whose intellectual achievement is poor than of those who have made better progress.
- 3 Looking at the positive side, an atmosphere in which children feel free to express their ideas and their emotions does two things. It enables the teacher to know what these are and so be able to provide suitable experiences for development, and it gives the children more opportunity to develop their powers of reasoning and discuss their feelings without fear of being ridiculed for being 'wrong'.

A Caring relationship (*audio-tape*)

The attitudes of the child can affect not only his approach to learning but also his effort and achievement. These attitudes develop both as a result of his experiences at home, at school and with his friends, and from the treatment he receives in these situations. Positive attitudes are likely to result in the child being successful, selfconfident, willing to experiment and to try new things and generally being better adjusted; whilst a child with negative attitudes is likely to feel he is no good, may lack effort and involvement and have only limited success.

Since the attitudes the child holds play such a vital role in determining his success or failure at school, it is essential that we do all we can to encourage positive attitudes in our children. The 'positive' aspect of their attitudes includes not only their attitude to themselves but also their attitude towards others, to school in general and to learning in particular.

Since the comments made to and about a child and the way others treat him play a major part in developing his attitudes we have to look at the type of treatment and comments which are likely to lead to positive attitudes. The single most important influence upon the child in the classroom is his teacher. The teacher can affect the child's attitude to himself and his work, and the better the relationship existing between the child and his teacher, the greater is the opportunity for the teacher to influence the child in the development of his attitudes. There is a clear correlation between the child's relationship with his teacher and his attitude towards school, and also between the way the teacher regards him and his school achievement. We see then the need for the existence of a good relationship between the child and his teacher. But what exactly do we mean by a good relationship and how can it be achieved?

We find some clues from children's comments about their teachers. In the magazine *Where* (September 1973) there was an interesting report about children's ideas of their teachers. The children had been asked such questions as who was their favourite teacher, what made him or her special, what was a good teacher in their opinion, what was the best thing that a teacher had ever said to them, and what was the worst thing ever said by a teacher. The children's comments seemed honest, perceptive and sensitive. They made frequent use of such phrases as 'kind', 'patient', 'helpful', and talked frankly about a good teacher as being

'someone who explains things properly,'
'who doesn't hurry you with your work,'
'who calmly explains mistakes,'

but who is approachable,

'I like being able to talk to my teacher,'

and who has a sense of humour. They saw a good teacher as one who is

'strict at the right times and soft at the right times.'

Their comments stressed the importance they attached to a teacher's ability to help them with their work, and also to make it interesting and meaningful. Although they valued the teacher for her help in their learning, their favourite teachers did more than this—they showed interest in a child as a person.

'I like her because I am shy and she chats to me.'
'She is my friend.'
'She really understands me.'
'She knows what each child is interested in.'

One child seemed to sum up all that his teacher meant to him when he made the cryptic comment: 'remembers'.

It seems that it is this concern by the teacher for the child as an individual which is important, and surely this is what we mean by a good teacher/child relationship. The child sees his teacher as approachable, a guide to help him with his learning, but also as someone who is interested in him. A good relationship will develop when the teacher can show the child that she values him and respects him as an individual.

But how do we convey to the child that we value and respect him? One of the most important qualities has been summed up in the word 'warmth', shown in the way a teacher is sensitive to the child's ideas and feelings, and in her kindness. Children respond to teachers' kindness, and attach great value to the occasional remarks which show feeling—one little girl, when talking of the best thing a teacher had said to her, remembered the occasion when her teacher had said:

'“you have a very nice smile; you must smile more often.”
After that the teacher gave me a wink.'

A child likes his teacher to show that she is aware of his life outside the classroom, to acknowledge the things which interest him. Many of the children's remarks indicated that it was the simple recognition that they existed outside the school which was important. A teacher's question: 'Did you have a nice birthday party?' was regarded by one child as the best thing the teacher had ever said to him.

The child appreciates this 'human' approach; he enjoys being thought of as a person with his own ideas and feelings. He likes to have his ideas listened to and viewed as worth while by his teacher. The good teacher builds on the child's ideas:

'Any ideas you have she will try them and not push them aside as some teachers do.'

Children value being able to play a part in planning and choosing their activities and like to be seen as responsible enough to do this. But they also want their teacher to value their efforts and see them through their eyes, not through her own, and to try to make sense of what they are trying to say. Many children's comments indicated how hurt they had been by brusque and insensitive remarks:

'I drew a copper beech, and my teacher said it was just a tree.'
'When the teacher said “Hurry up with that poem, I know your poems, they go on and on”.'

It is not only thoughtless remarks which may damage the teacher/child relationship, it may also be hasty actions:

‘She jumps to conclusions,’
or lack of genuine interest:

‘She never watches the drama plays we do. Instead she pats her hair and daydreams or marks books and tuts,’

or a lack of regard for a child’s efforts:

‘I don’t like her throwing away paintings which she doesn’t think are any good.’

Perhaps these ideas from children have gone some way to show what it is that the child feels is important in the relationship with his teacher. When the child values his teacher and sees her as a warm and interesting person, then she is better able to affect the development of his positive attitudes. It is evidently important for a teacher to get to know her children, to make efforts to find out about their ideas, their feelings, their interests and to respect them as people. Taking individual differences into account means making allowances for weaknesses, building upon strengths and not expecting children to act or react in the same kind of way as each other. It’s necessary too for a teacher to adapt herself and her approach to suit the children more than sometimes happens, instead of always expecting the children to adapt themselves to her demands. If we are sensitive to a child’s individual wishes and are prepared to listen to him and act upon what we hear, we will go some way to providing an atmosphere in our classrooms which offers each child security and the opportunity to develop at his own rate and in his own way.

Discussion points

- 1 It is suggested that a child’s attitude to school and to learning is determined to a large degree by his relationship with his teacher. What evidence from personal experience can you cite in agreement or disagreement with this?
- 2 Many of the points are drawn from looking at the teacher’s behaviour from the child’s point of view. The examples of children’s ideas about their ‘ideal’ teacher given in the Supplementary Material (page 229) add further evidence of this kind. To what extent should we take serious notice of how the children would like their teacher to behave?
- 3 To offer each child ‘security and the opportunity to develop at his own rate and in his own way’. Is this in conflict with the undeniable necessity for children to conform to expectations set by influences outside the school? Are we making too light of the hard truth that some children will be judged to be ‘better’ than others?

The teacher's role—positive action

Attitudes and feelings are built up by the accumulating impact of many experiences, so the guide-lines which can be given are necessarily general in character, applying to a variety of situations rather than to particular activities.

The following kinds of teacher behaviour emerge from the earlier points as some most likely to encourage positive attitudes. You will no doubt wish to add others.

As has been said of other aspects of matching, there can be no guarantee that these things *will* have the desired effect on the children's development, but they are the ones most worth trying.

- 1 The teacher finds out about the children's attitudes and feelings, through discussion and conversation with, but above all, by listening to them.
- 2 She shows real interest in what they feel as well as what they think.
- 3 She acts upon her knowledge of their development of attitudes and feelings by setting realistic expectations, i.e. she does not expect more co-operation or responsibility, for example, than is appropriate to their degree of maturity.
- 4 She provides a framework which supports positive attitudes, for example an organization of materials which enables children to look after them, and time to finish work so that the satisfaction of achievement rewards perseverance and co-operation.
- 5 She shows that she values positive attitudes, by praising effort and socially desirable behaviours, not just achievement.
- 6 She sets an example in her own actions and responses of positive attitudes and desirable characteristics, e.g. patience, keeping her temper, being fair, sympathetic, encouraging.
- 7 ... (add others) ...

The application of these general points to the development of particular attitudes is discussed in sections of *Finding Answers*:

Curiosity	— Page 12
Co-operation	— Page 25
Perseverance	— Page 36
Responsibility	— Page 44

You may like to try to apply the same general ideas to the other attitudes by tackling the questions to be found on the following pages:

Open-mindedness	—Page 64
Self-criticism	—Page 69
Independence	—Page 60
Originality	—Page 63

The teacher's role—behaviour to be avoided

The teacher who manages to display the six kinds of behaviour listed above is something of an unnatural paragon!

Even so the effect on the children may not be all that is desired, because of the uncertainty in knowing how to match experiences to encourage development. Since, however, we can be more certain about the negative effect of certain teacher behaviours it is worth while to bring these out. So, here are some suggestions of behaviours which emerge as being harmful to children's attitude development and which might well be avoided if we want to prevent mismatching. Again, other items should be added.

- 1 The teacher should not feign interest —it does not convince the children and may be worse than showing no interest.
- 2 She should not make a child's failure public.
- 3 She should not punish by word or action one child for the faults of another.
- 4 She should not make hasty judgements before giving a child the chance to explain his actions or his feelings.
- 5 She should not make decisions for the children which they could make themselves.
- 6 She should not encourage competition between children which results in one being valued more highly than another (one is a better footballer or better at working out sums or writing poems, but not just 'better' than another.)
- 7 . . . (add others) . . .

Supplementary Material

List of attitudes, abilities and concepts which emerged from discussions with teachers.

A) Earlier Development

Attributes	Meaning in terms of behaviour
<i>Curiosity</i>	Looking carefully, perhaps for some time, at new or unusual things; using several senses where appropriate and noticing details. Asking questions aimed at understanding the way things are put together or how they function.
<i>Originality</i>	Producing from his own thinking or imagination ideas or things which are new within his own experience.
<i>Perseverance</i>	Persisting despite difficulties or the amount of effort required, as long as there is evident chance of progress towards a goal. Trying a different approach rather than persisting with an unsuccessful one.
<i>Open-mindedness</i>	Being generally prepared to listen to other points of view; accepting ideas which are new if the evidence is convincing after consideration.
<i>Self-criticism</i>	Voluntarily indicating dissatisfaction with his own work or ideas and attempting to make improvements.
<i>Responsibility</i>	Getting on with the work and performing the duties expected to the best of his ability without constant supervision. Attempting to overcome problems himself before asking for help.
<i>Willingness to co-operate</i>	Responding to the needs of others for help or for materials, trying to fit in with others, and settling differences by discussion.
<i>Independence</i>	Being prepared to make up his own mind after considering evidence, and to defend his ideas or conclusions rather than change them just to be in agreement with others.

<i>Observing</i>	Taking notice of many different aspects of objects or situations, especially the new or unusual, as shown through comments made, actions, writing, drawing, etc. at the time or later. Making use of many senses.
<i>Raising questions</i>	Querying observations or findings which are not understood rather than accepting them without question. Asking the kinds of question to which answers can be sought by exploration or enquiry, and framing them so that the problem is clear enough to know what information or explanation is sought.
<i>Exploring</i>	Actively trying something out to find out what happens, or examining an object or situation to see what is there. Extending an activity to explore different aspects uncovered as observations are made.
<i>Problem solving</i>	Carrying out a course of action to tackle a problem he has found for himself or been given. Approaching a problem in a systematic way, identifying and isolating the effective variables.
<i>Finding patterns in observations</i>	Giving an account of observations or experimental results which is more than a bare description of what was found, and showing that he was attempting to look for patterns in the evidence.
<i>Communicating verbally</i>	Presenting information, orally or in writing, to tell others about an activity, observation or experiment in a way which enables them to follow a line of argument or grasp some ideas. Being able to understand information or ideas expressed in written or spoken words.
<i>Communicating non-verbally</i>	Giving others a clear idea of something which has been observed or found out using charts, drawings, graphs, tables, numbers, symbols, models, actions, to replace or supplement words. Being able to understand information communicated in these forms. Choosing the more appropriate form for communicating which will help others to grasp and understand the information.

<i>Applying learning</i>	Using what is learned in one context to solve problems in another context. Appreciating what is common between a new and a previous situation and using this to apply relevant experience.
<i>Classifying</i>	Separating objects or events consistently according to features which are chosen or given. Being able to reclassify one set of objects according to different features.
<i>Concept of cause and effect</i>	Proposing an explanation from observations made, of what causes particular effects and what might be the mechanism linking cause and effect. Using this relationship to suggest what might happen if certain changes are made.
<i>Concept of time</i>	Appreciating that time is continuous and that events are linked by the order in which they take place and the time intervals between them.
<i>Concept of weight</i>	Knowing that weight is how much an object is pulled down to earth, as distinct from its size or nature. Appreciating that for practical purposes the weight of an object in any particular place is not observably affected by changes which make it look different but do not involve anything being added or taken away.
<i>Concept of length</i>	Appreciating that the length of something is along it, which may not be the shortest distance between its ends, and that the quantity remains effectively the same when only the position or shape of an object is changed.
<i>Concept of area</i>	Area as the amount of surface across the face of an object, which remains effectively the same in total when the surface is moved or divided up.
<i>Concept of volume</i>	Appreciating occupied volume as the amount of space taken up by the whole of an object, and capacity as the space within an object which can be filled. Being able to determine whether there is any measurable change in volume when, through a change in shape or position, there appears to be an increase or decrease.
<i>Concept of life cycle</i>	Identifying as living the forms of life at various parts of the life cycle and knowing the sequence of development.

B) Later Development

Attributes	Meaning in terms of behaviour
<i>Curiosity</i>	Looking carefully, perhaps for some time, at new or unusual things; using several senses where appropriate and noticing details. Asking questions aimed at understanding the way things are put together or how they function.
<i>Originality</i>	Producing from his own thinking or imagination ideas or things which are new within his own experience.
<i>Perseverance</i>	Persisting despite difficulties or the amount of effort required, so long as there is evident chance of progress towards a goal. Trying a different approach rather than persisting with an unsuccessful one.
<i>Open-mindedness</i>	Being generally prepared to listen to other points of view; accepting ideas which are new if the evidence is convincing after consideration.
<i>Self-criticism</i>	Voluntarily indicating dissatisfaction with his own work or ideas and attempting to make improvements.
<i>Responsibility</i>	Getting on with the work and performing the duties expected to the best of his ability without constant supervision. Attempting to overcome problems himself before asking for help.
<i>Willingness to co-operate</i>	Responding to the needs of others for help or materials, trying to fit in with others, settling differences by discussion.
<i>Independence</i>	Being prepared to make up his mind after considering evidence, and to defend his ideas or conclusions rather than change them just to be in agreement with others.
<i>Observing</i>	Noticing all kinds of details or changes, using several senses where possible, as shown by comments, records made, or actions taken at the time or later. Distinguishing between observations relevant to a particular problem and those which are not relevant.

Proposing enquiries

Defining problems or questions in a form which can be investigated, and taking part in devising ways to test ideas or find things out. Recognizing the variables in a situation and planning how to investigate their effect in a controlled manner.

Experimenting/ investigating

Working through a series of actions with an awareness of how each step is related to the aim of the enquiry. Being systematic and using equipment and other materials, including reference books, effectively.

Communicating verbally

Expressing information in words, either orally or in writing, so that it can be understood from the point of view of one who receives it. Putting items in a reasonable sequence and choosing appropriate words. Similarly being able to understand written and oral communication from books, the teacher and other pupils.

Communicating non-verbally

Being able to understand and express information partially or wholly in a non-verbal form, i.e. in charts, drawings, diagrams, graphs, tables, numbers, mathematical symbols, models, action, etc. Selecting the mode of communication which is best suited to the information and the recipients.

Finding patterns in observations

Explaining the meaning of observations or finding in terms of the problem or question being studied. Using previous experiences to infer a relationship between findings and to explain the patterns observed in them.

Critical reasoning

Being able to analyze a statement or conclusion and use logical reasoning to assess its validity. Making use of knowledge already possessed combined with new evidence in pursuing an argument or reasoning out a problem step by step. (Factual accuracy is less important in this context than the logical consistency of the reasoning.)

Applying learning

Appreciating what is common between a new and a previous situation and so bringing relevant experience to bear in new contexts. Spontaneously recalling and using what has been learned previously to help solve problems in new situations.

*Concept of
cause and effect*

Proposing an explanation based on observations for how particular effects are caused, and identifying the mechanism linking cause and effect when this is observable. Using the observed relationship to predict what might happen if certain conditions are changed.

*Concept of
measurement*

Appreciating the process of measurement as the repeated comparison of a quantity with an agreed unit amount of the quantity and realizing the uncertainty in all measurements.

*Concept of
volume*

Recognizing volume as the space taken up by an object, and capacity as the space within an object which can be filled.

*Concept of
force*

Recognizing that a force is that which is acting whenever the motion of an object is changed.

*Concept of
energy*

Recognizing as energy that which is transferred from one object to another when there is interaction between them.

*Concept of
change*

Appreciating that change is not spontaneous but always results from some interaction even though the mechanism may not be known. Being aware that there are different kinds of change and of the circumstances in which these take place.

*Concept of
interdependence
of living things*

Recognizing the relationship between living things linked in a food chain, and the ultimate dependence of animals upon plants. Appreciating some of the conditions which make for balance or imbalance in the relationship of living things to each other.

*Concept of
adaptation*

Appreciating that the form of living things has changed and is changing, and relating changes to environmental influence. Having a broad idea of the relationship between function and structure in living things.

‘Things to look for’

Suggestions of behaviours relating to problem solving, curiosity, the concept of length.

Problem solving

- 1 Does he ever spontaneously suggest a way of tackling a problem?
- 2 Does he expect others to tell him how to set about solving a problem?
- 3 If he suggests a way of tackling a problem does he have any idea of what his suggestion will lead to?
- 4 Has he any idea of possible results of tackling a problem in a certain way?
- 5 Does he ever suggest more than one way of approaching a problem?
- 6 Does he compare, by discussion or experiment, the advantages of different approaches to a problem?
- 7 Does he check that what he is doing is really relevant to solving the problem?
- 8 Does he keep in mind the whole problem, or ignore part of it in suggesting an approach?
- 9 Can he state what steps he will have to take in solving a problem?
- 10 Does he continue to think about or work on the problem outside school?

Curiosity

- 1 Does he notice new things in the classroom?
- 2 Does he show an interest in new things once his attention has been drawn to them?
- 3 Does he show a sustained interest, or does his interest flit from one thing to another?
- 4 Does he just look at new things, or does he use all his senses to find out new things?
- 5 Does he ask questions concerned with 'What' rather than 'Why'?
- 6 Do his questions lead to further lines of inquiry, or is he satisfied with the answers he receives?
- 7 Does he find new areas of interest in familiar things?
- 8 Is he interested in all new things, or only in certain things?
- 9 Once his interest has been aroused, does he continue to find more things which he wants to find out about?
- 10 Does he just enjoy the novelty of a new experience, or does he seek to understand it in the light of his previous experiences?

Length

- 1 Does he use the words length, long, longer, shorter, short?
- 2 Does he ever claim that the same object can have a different length if its position or orientation is changed?
- 3 Does he ever confuse length with thickness or width?
- 4 Can he correctly describe the differences between two objects which differ only in length?

- 5 Can he put three objects in order of length? If they differ only in length, and if they differ in other respects besides length?
- 6 Can he arrange more than three objects correctly in order of length?
- 7 How does he react if an object is deliberately moved so that it looks to be different in length in its new position?
- 8 If he has two objects of the same length and one is moved away, what does he say about the lengths of the two after the move?

Using tests: some pros and cons.

There are many different types of test and a variety of purposes which they can serve. Here we are concerned with the advantages and disadvantages of tests *for the purpose of gathering information for everyday decision making in the classroom*. The features of tests which are disadvantages for this purpose may well be advantages for other purposes, and we do not wish to suggest that tests have little value at all, which would not be true.

Although tests can be categorized in many different ways the distinctions most relevant to this discussion are between

- standardized tests,
- criterion-referenced tests,
- teacher-made tests.

Standardized tests have been carefully prepared, refined and given to a large number of children in order to find the average or 'norm' for a particular group. Scores of pupils taking the tests are based on a comparison of their performance with the 'norm'. Criterion-referenced tests compare an individual's performance with a level of performance which has been decided as being the criterion for mastery of a particular skill, ability or concept. Teacher-made tests have not, of course, been given to a large number of pupils, but often an attempt is made to distribute scores around an average (e.g. to give 5% A, 20% B, 50% C, 20% D and 5% E). Alternatively teachers' tests can be criterion-referenced and there is the possibility that all the children could be given A, or all E, in extreme cases.

Features of tests which are advantages for various purposes are:

- 1 A test puts children in certain situations or gives them problems which are the same for everyone, so in one sense it can be said to be fair.
- 2 A test can be constructed so that the marking is as objective as possible; again this makes for fairness.
- 3 Results of tests enable comparisons to be made between pupils (norm-referenced), or between one pupil and a standard performance of some kind (criterion-referenced).

- 4 If similar tests are given occasionally the cumulative records of attainment can provide a kind of 'dip-stick' indication of progress over a period of time.
- 5 The administration of a battery of diagnostic tests can help in detecting areas of difficulty encountered by the children, and is especially useful in cases of children who are not achieving according to expectation.
- 6 A teacher-made test may be a quick way for a teacher to find out if children have grasped a particular idea or skill.
- 7 A standardized test can enable a teacher to find out how well her children are achieving compared with the general level for the age group.

However, for the purpose we are considering, the provision of information needed for decisions about the learning experiences of individual children, what is needed is a method which, ideally, would have these features:

- can be used frequently and repeatedly,
- can be used for individual pupils as necessary without affecting others,
- does not require special equipment or preparation,
- does not take up time from or interfere with learning activities,
- does not disturb pupils or make them anxious,
- provides a valid assessment, not one arising from a snap judgement,
- gives information about the wide range of behaviours which is encompassed by the aims and objectives of education.

It is not difficult to see that tests of any kind do not have many of these features which are required for the present purpose. Specifically their disadvantages in this context are:

- 1 The same test cannot be applied over and over again. Some standardized tests provide parallel forms but rarely more than two, so continuous monitoring would not be possible. Teachers could devise several tests but would never know whether changes in scores were due to changes in pupils or variations in difficulty of questions.
- 2 Tests are generally given to a whole group at one time because they require a great deal of time if administered individually. Neither group nor individual tests can be used frequently or repeatedly.
- 3 A test situation induces anxiety in many children, and sometimes in their teachers and parents, too, which is transmitted to them and adds to the stress they feel. Moreover a test takes place at a certain time and the result may depend on how a child feels, physically and emotionally, at that time. The result may not reflect his true potential performance.
- 4 A test gives a result which is based on performance in the problems

- or situations presented in the test, and these are necessarily only a few instances in which achievement of a certain ability might show. Thus the apparent fairness of giving the same items to everyone may in fact be introducing unfairness—some children might fail on the particular problems in the test but might have succeeded if slightly different ones had been given.
- 5 The atmosphere surrounding the test is often unavoidably one of competition between pupils and not co-operation. Results need not be used to compare one with another but they frequently are, and only those at the top of the list gain in self-esteem or satisfaction.
 - 6 Expressing test results in numbers, raw scores, percentages, percentiles or anything else suggests a precision which is not justified. Even on an objectively marked test a score of, say, 106 might really mean 'anything between 96 and 116' but frequently this uncertainty is forgotten once a numerical result is obtained. Tests are generally felt to be more precise and objective than they really are, or ever could be, and perhaps we should be more sceptical about their meaning. Test results can be valuable in certain circumstances but are not necessarily more valid than other information, such as a teacher's judgement.
 - 7 A further disadvantage of tests is that the result is generally expressed as one overall figure—an I.Q. of 110, or 70% in mathematics, smudging out the peaks and troughs in achievement of different kinds which are so valuable in helping a child to improve his weak points. When overall scores are broken down into sub-scores, as in some tests, the error in the figure is greatly increased (often so much that a standardized score could be 15 points greater or less than the value obtained).
 - 8 The nature of the information given by standardized tests is not very useful in trying to help an individual child. The information needed is not about his position with respect to other pupils but about his progress towards attaining various skills, kinds of knowledge, attitudes etc.
 - 9 Finally the nature of tests restricts the range of characteristics which can be assessed. Most tests depend heavily on verbal communication, and even in individual tests it is difficult to assess things such as ability in observation, questioning, exploring; and few attitudes can be satisfactorily tested in the case of primary children.

Examples of child studies produced by teachers

Carol (8 years, in a mixed age class of 7–9 year olds.)

(Carol is a problem to her teacher not because her work is poor but

because she is ahead of the others in her class in several respects and it is difficult for her teacher to give her something to get her teeth into!)

Carol has a tendency to be temperamental at times and reluctant to do the work she is told to do even though she is capable of doing it very well. She is very good at mathematics, knows her tables well, and rarely makes mistakes in her maths work. This seems to make her 'cocky' and a bit of a 'know-all' in the eyes of the other children. She has only shifting friendships and gets on best with children who are older than herself.

The stories she writes are imaginative and she makes good use of descriptive words, but she uses speech marks rather uncertainly and does not space her words on the page very well. She reads fluently but generally chooses Enid Blyton from the library.

Her art work is well controlled and shows an eye for detail. She is beginning to draw figures more realistically.

She is quick to pick up new ideas and applies what she has already learned readily in learning new things.

She seems to have a good feeling for music and takes trouble over her recorder and guitar playing.

Sometimes she shows that she is capable of sticking at things for a considerable time but this does not happen very often.

Peter (7 years in a mixed age class of 7-9 year olds)

(Peter has recently come to the school, where most of his classmates have been for at least two years. There are problems in getting him to fit in with the 'ways' of the school and accept his part in various routines.)

Peter very easily becomes over-excited; he shows no responsibility if he is not supervised fairly constantly. He will stand on the table, start a fight or begin to shout at the slightest invitation. This behaviour seems to stem from 'high spirits' rather than any deliberate intention to be disruptive. Even when he is not jumping around he seems to be always fidgeting, humming or interfering with other children. His classmates find this irritating and Peter frequently senses this and withdraws to work by himself at the side of the room. His response to any attempt to change his behaviour is to do something else or remove himself rather than try to fit in.

His writing is neat and he expresses himself quite clearly on paper. He is also well above average in mathematics, but is still worried about whether he is doing well. Anything which he can do by himself is usually done well, but when he has to work with others he seems to forget what he is doing and provoke horse-play. So his science work, usually done in groups, is poor, and so is his art and craft since he usually has to sit with others to do this.

He recently indulged in some free art—writing on the school walls—which none of the other children has ever done. When he was spoken to about this he did not see anything wrong—he said that where he came from before all the walls were written on.

Michael (11 years old)

(Michael seems to have more ability than he shows but he never makes an effort. His teacher fears that he is destined for the 'slow stream' throughout the secondary school unless she can help him to try harder.)

Michael always does the minimum that he can get away with. Attempts to encourage him to extend himself meet with a reaction 'but I'm no good at it'. He will talk for hours, particularly about football, but will write only very few words using a narrow vocabulary and little imagination. In mathematics he makes many errors which he could have avoided with a little thought since he can reason quite well in discussion. He hardly ever completes a picture or a piece of craft work because he spends so much time 'messing around'.

Physically he is well developed and is good at his beloved game of football. An only child, he tends to expect others to do things for him and often opts out of the jobs for which he should be responsible. His reading in class is about average but he rarely chooses a fiction book, preferring books on football which are quite demanding to read. In science he does sometimes make suggestions but too easily changes his mind to follow someone else's idea; he seems to follow what is done but cannot—or will not—think it out for himself.

Conversations

The Robin's Nest

This conversation took place between a teacher and a small group of children in a family grouped infants' unit. The nest had been found on the school site in the roof of a building which was being taken down by workmen.

TEACHER What did you notice first, Helen?

CHILD There are lots and lots of feathers around the top of it.

TEACHER Yes. I was wondering about how the feathers came to be there.

CHILD Well, I thought that when the bird sat on it...all the feathers...when they sat on it...they got caught on there when they flew off.

CHILD Well perhaps when it was frightened away by the hammer the feathers could have fallen off in its fright...

CHILD They've been collected. They've been collected for the nest.

TEACHER Who's collected them?

CHILD Mrs. Robin.

CHILD She's collected them from where she could find them to make a nice soft cover at the bottom of the hole there for the babies.

CHILD To keep the eggs warm.

TEACHER Yes, that's very important. But the nest isn't all made of feathers is it?

CHILD No it's made of moss and straw and...well mud and some grass.

CHILD There's things woven in and out of it and it's different all the way round...

CHILD How do they weave it?

TEACHER They're very clever—

CHILD Birds are very clever with their beaks.

CHILD Nobody would ever think they were because they're so small.

TEACHER Yes, it's very wonderful isn't it? If we turn this right round and let you have a look at this side. Isn't that lovely! Look what's on this...

CHILD It's a bit muddier and there's lots of straw.

CHILD It's been woven like that...and then like that...like that...it's been woven in and out.

TEACHER Which end do you think the bird came in by?

CHILD That end. It flew up in there and...trotted up here.

TEACHER Which part of it do you think was the nearest to the outside of the building? Which would you suggest?

CHILD That one.

CHILD Yes because if she came from there she'd have to come from that side and land on there and then walk up...

TEACHER Yes?

CHILD ...because if she came in that way if that was the entrance she'd have to jump over there, which would be a bit silly because she'd miss the nest altogether...

CHILD What's this stuff here?

CHILD Hair, it's hair.

CHILD I bet it's sheep's wool.

TEACHER You think it...you feel it.

Pause

CHILD It feels a bit like sheep's wool, because people think that sheep's wool is soft but it's quite rough really.

TEACHER It is. I wonder where it came from.

CHILD I suppose she fluttered near a farm. 'Cos there's a farm near us.

TEACHER You think she will have flown all that distance with the sheep's wool in her beak?

CHILD It would have slipped out.

The children notice that the eggs in the nest have holes in them—they have been blown.

CHILD Why have they got holes in them? Have the birds been pecking out?

CHILD I suppose they started pecking and then because their mother left them they died.

TEACHER Shall I tell you how the holes really got there?

CHILD Yes, yes.

TEACHER You see if we had left the eggs as they were...

CHILD Yes.

TEACHER ...all that was left inside them would have gone bad because the little birds hadn't started to form. You know what an egg is like inside, don't you?

CHILD Yes, all yolky and gooey.

TEACHER Yes, well with time, and with the mother's warm, that yolk...

CHILD ...had to develop...develop into a bird...

CHILD That's quite magnificent, really.

TEACHER It's absolutely wonderful, I think so...

CHILD ...how many days does it...

CHILD ...I don't know how it happens but it's ever so... clever!

CHILD How many days does it take to...er...um...hatch a bird?

TEACHER Well, you've asked me a question that I can't answer—how many days it would take—but there's a way that you could find out, do you know how?

CHILD No...

CHILD Watch it.

TEACHER Where would you get information like that from?

CHILD A bird watcher...

CHILD A book.

TEACHER Yes, this is something you can look up in a book and when you've found out...

CHILD ...I've got one here, somewhere.

One child runs to bookshelf and returns straight away.

CHILD ...here, here's a page about them.

TEACHER There we are. See—that's...

- CHILD That's how it forms, that's how it begins—then it . . .
- CHILD That's when it's 48 . . .
- CHILD . . . hours . . .
- TEACHER and that's 7 days later . . .
- CHILD 14 days later . . .
- CHILD It takes 14 days to hatch!
- TEACHER It takes 14 days for that bird to hatch. I don't know if it takes the same length of time for every bird. That's something I would have to find out.

On the question of gravity

In this exchange the teacher was trying to explore the ideas the three children already had about gravity as a preliminary to some work on falling objects and projectiles. The children were in a top junior class.

- TEACHER Do you think—now you'll have to think hard about this—do you think that wherever you were you'd still weigh the same amount?
- CHILD No.
- TEACHER Nicholas says 'No'. Teresa shakes her head. Christopher shakes his head. You don't. Now who can tell me where you think you wouldn't weigh the same and why? All right . . .
- CHILD When it's sunny . . . um . . . your body gets all hot and it all melts into liquid.

Pause

- TEACHER Like ice melting do you mean?
- CHILD Mm.
- TEACHER Anybody else got any ideas?
- CHILD Well if you're in the desert and it's very hot and you don't really want to eat much . . . 'cos you might get fatter and it's difficult to move around and you don't really want to wear much. It's very hot, you don't really want to eat much, you just drink a lot and that doesn't put on weight really.
- TEACHER So you think—really two people have said that you wouldn't weigh the same if you were somewhere really hot. Anybody think there is anywhere else where your weight wouldn't be the same?

Pause.

- TEACHER Can't think of anywhere? No?
- CHILD Where it was very cold you would eat things that were very hot and they would . . . I don't know really . . . you'd just eat hot food like soups.

- TEACHER You think that would make you weigh more than . . . or less?
- CHILD You'd eat more if you were cold.
- TEACHER Nicholas?
- CHILD If it's very dry you'd have to drink a lot and you'd get a lot of liquid in you.
- TEACHER Mm.
- CHILD It weighs you down, it weighs more than other foods.
-
- TEACHER Well, then, do you think—if I were very clever and very, very brave—and I went and climbed to the top of Everest, which is very, very high—it's the highest mountain in the world isn't it?—if I climbed to the top of Everest, do you think at the top of Everest I would weigh the same as I weigh here?
- CHILD No.
- CHILD Because all the exercise you put in climbing up the mountain it would (?) up and you would be less weight.
- CHILD Yes, fatness just falls off you when you get a lot of exercise. It doesn't come off in chunks so that you can see it . . .
- TEACHER What do you think then, if I got to the top of Everest, do you think then that I would weigh less or more?
- CHILDREN Less, less.
- TEACHER And the reason being . . . why would it be, then, Nicholas?
- CHILD Because when you climbed the mountain and you exercised and it all (?) up and you wouldn't . . .
- TEACHER Well supposing I went in an aeroplane and dropped by parachute—and landed on the top of Everest. So that I hadn't had all the exercise to get to the top, would I weigh the same at the top of Everest as I do here, do you think?
- CHILD I think the same.
- TEACHER You think I'd be the same, Lawrence?
- CHILD Yes.
- TEACHER You do, Teresa, does everybody think I'd be the same?
- CHILD Yes.
- TEACHER You do. Right then. How many of you have seen films on television of men going off into space? (*Pause*) Teresa? . . . Nicholas? . . . you all have, have you, in the new, yes. Well, what happens to them as they go off into space?
- CHILD They can't breathe, 'cos there's not any . . . enough oxygen in the air.

Is science being learned here?

We have posed the question : if you walked into a classroom how would you recognize that the class or a group were engaged on a science activity as opposed to another kind of activity?

Here is an attempt to answer the question in two stages. In the first place situations which provide *opportunity* for learning science can be recognized. Such situations are an important starting point but may or may not be followed up, so the second part of the answer suggests the indications that the science in a situation is being *developed*.

Children have *opportunity* for learning science where they are :

- themselves handling materials, living and non-living,
- designing, making or manipulating apparatus using a variety of materials, including junk items,
- moving around freely and finding the materials they need,
- discussing their work with each other or with the teacher,
- busy doing things which they feel are important,
- trying to work out for themselves what to do from step to step, and not expecting to be told what to do,
- puzzling over a problem,
- comparing their ideas or observations with those of others.

The science in a situation is being developed where children :

- have a clear idea of what they want to find out, investigate or observe,
 - take the initiative in suggesting what to do and how to set about it,
- try out ideas ‘to see what happens’,
- observe things closely—perhaps watching, listening, touching, smelling,
- try different ways of approaching a problem,
- classify things according to their properties or characteristics,
- make some record of what they find out or observe,
- use instruments for aiding observation or measurement,
- devise and apply tests to find out what things will do,
- make predictions of what they expect to find or to happen,
- look for evidence to support the statements they make,
- try to quantify their observations,
- confirm their findings carefully before accepting them as evidence.

We do not include here any items about the organization of the class, e.g. ‘the children are working in small groups or individually.’ For several items an informal organization is a prerequisite but there are several ways of organizing a class which enable children to do the things listed here. The interests of the children and the preferences of the teacher will be important factors in determining organization but

a teacher should be watchful that a particular form of organization does not preclude the possibility of children being able to do all of the things in the list at some time.

How the video-tapes were made

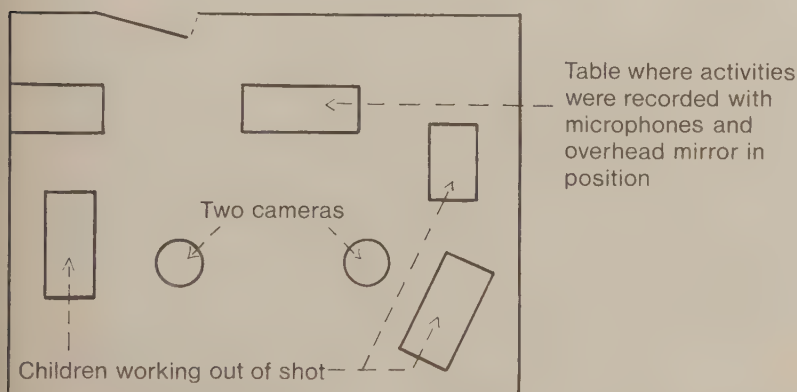
In order to illustrate the meaning of various statements about children's behaviour we needed some examples of real children engaged in real activities. Video-tape seemed to provide the obvious means of having examples at hand. Since the project is trying to help teachers make observations and interpretations of the way children carry out their usual activities it was clear that video-taped examples of 'normal' work would be best. Our first attempts to make recordings in the classroom, interfering as little as possible with the work going on, ran into considerable technical difficulties: the camera, though portable, inevitably seemed to reach the best position for catching an activity just as the children finished, the microphones picked up all the background noise and very little of the talk of the children in the picture, and of course the whole set-up, with cables and technicians around was far from unobtrusive. Needless to say, the results of several days' work were unusable.

At this point we were fortunate that, through the offices of Mr. David Wilson, of King Alfred's College, Winchester, we made contact with the Wessex Educational Television Unit which is based at King Alfred's. The director of the unit, Mr. Tony Lee, recognizing our problem, gave us advice based on experience of making classroom recordings in a variety of circumstances. It seemed that we would have to accept that what we could record would never be quite 'normal' - the very presence of the equipment made the situation abnormal - and that to obtain a product which was bearable to watch it was necessary to set up suitable conditions for the recording to be made. The classroom would have to be prepared beforehand, with lighting, overhead mirror, cameras and microphones carefully positioned, and the background noise reduced by having a relatively small number of children in the room at a time. The cameras would record the activities of one group of children for a prearranged time and not try to move from one group to another during this time. These were the conditions imposed by technical considerations using the equipment available to the Wessex Unit; probably more sophisticated and more expensive equipment would have given greater flexibility but we had to work with what was there. If we kept to the advised arrangements the product would be technically satisfactory, so our task was to make things as 'normal' as possible as far as the children were concerned within the necessary restrictions.

Recordings were made in two schools, at Stockbridge County

Primary School, in November 1974, and at Tanner's Brook Middle School in June 1975. The set-up at both schools was much the same, and demanded careful organization beforehand since there was inevitably some inconvenience caused to the schools. A classroom was vacated for our use, for a period of a week at Stockbridge and three days at Tanner's Brook. The recording involved altogether eight people: a team of four from Wessex ETV (two cameramen, engineer and director), two from the project, a teacher (to work with the children) and David Wilson who was responsible for liaison with the school and for organizing the equipment.

Before recordings were made a day was spent by the Wessex team preparing the classroom. The arrangement was something like this:



While this was going on the other four were organizing activities and trying them out with some children, and arranging with teachers the groups to be involved in the recording. The activities we provided for the children were ones which we considered would be interesting to them, involve them in problem-solving and give them opportunities to show their development in various of the abilities, concepts and attitudes relevant to learning science.

On each day of recording we worked with a group of children from one class for the whole day. In the first half of the morning there was no recording made, but the children worked in the room with the lights on and cameras manned. They had the chance to ask questions about the equipment, become acquainted with their temporary teacher and try some activities similar to those we were going to record later. After the break, the children came back to new activities and the group at the 'target' table were recorded for twenty minutes, then things were changed round so that a different group engaged in different activities were recorded for the next 20 minutes, after which a third change was made. Whilst recording took place only the teacher was in the room

with the children — apart from the cameramen who deliberately made no contact at all with the children. Outside in the control 'van' the director and engineer were selecting shots and directing the cameramen, with the project team watching the classroom events on a monitor.

A second recording session of one hour took place in the afternoon, the children being completely 'warmed up' by then. Although the recording for each group lasted for a fixed time the children were able to finish their activities, or start others if they wished on the tables out of shot in the classroom. The teacher was busy looking after groups at all tables and was not giving special attention to the 'target' table group, so we could see how the children worked things out for themselves. Table microphones only were used with the primary school children but in the middle school radio-microphones were pinned on the children.

On completing the recording we had produced eight hours of material from Stockbridge and four hours from Tanner's Brook. Selecting extracts from this was a daunting task and the tapes had to be reviewed several times. The ideas we originally had about the kind of sequences we were looking for were modified to some extent by the material itself, but we tried to pick out parts where the children's behaviour already indicated something about their development. The problem of selection was enormous — after all, one can learn something about children from almost any sample of their behaviour. However after identifying the most clear examples which were relevant to our purpose we organized them into suitable units and made a plan for editing. Introductory remarks and 'voice-over' comments were recorded separately and then the editing was carried out by the Wessex technicians who also added titles, etc.

After the Stockbridge recording, selected sequences were put together to make ten different trial tapes, each consisting of five to eight sequences and each lasting about 15 to 20 minutes in total. These were used in trial in-service courses and evaluated in discussions, resulting in the decision to make further recordings with some older children and to re-edit the sequences, which it was generally agreed were too long. The additional recording was carried out at Tanner's Brook, and new products made, incorporating sequences from both schools. Further trials of these provided feedback which guided the production of the final versions.

The two teachers seen on the video-tapes were not teachers at the schools, but willing helpers who were involved in the planning of the whole operation. In the work at Stockbridge the teacher was Mrs. Sonia Hughes, at that time taking an in-service B.Ed. course at King Alfred's College. Monica Murphy, then a member of the project team, also did some of the teaching for the Stockbridge recordings. At Tanner's Brook the teacher was Miss Kathy Phillips, who was taking a course of further professional study at Reading University.

An approach to using the check-list for infants' work

Sister Anne leads a team of three teachers and a helper who work co-operatively in a family grouped infants' unit, with children from 5 to 8. As a member of the project team Sr. Anne had helped in the development of the check-list and several parts of *Finding Answers: A Guide to Diagnosis and Development*. When the check-list was introduced to the other teachers, they had difficulty making use of it and so Sr. Anne devised ways of helping them, in the first instance, to pick up the information needed to relate the statements to the children, and then to provide activities likely to match the stages reached by various children. She describes how this was done in the following conversation.

SR. ANNE I wanted to get it down so that the teachers had something specific to look out for, because Mrs. B. had said 'I don't want to put a mark in here because I don't really know what I'm looking for, and I might put something down which is not useful'. So I put down on paper what I would do if I had a few minutes to spend with each child, and I really wanted to know the way that they were thinking. Now I did say, 'Don't use these as the only way of getting information but modify what you know of the child in the light of it. Let it be another piece of information.' And this is what they did. They are rather like the Nuffield Maths 'Checking-Up' ideas—not really little tests, but just designed to look out for something specific.

I brought plenty of material in here [one of the home bays in the co-operative infant unit], and then one lunch hour we brought a cup of coffee in here and we asked Robin in, and I said, 'We'll watch how he reacts to the material, and then I'll break in and start to talk to him about it and try to draw these points out.' So this is what we did. They saw that all the way through, and we discussed where we would place the child according to the check-list statements from that information. Then they went through the actions themselves with other children. Then it seemed that they then knew much more clearly what they were looking for. They said they had come to terms with what they were looking for, also with what the statements were meaning. Afterwards they said they had previously been mistaken about a child and changed their minds from when they first tried to use the check-list last term—you know, they've said 'I know I made a mistake from what I have heard him say and what I have seen him do this term,'—which is an indication that they are working with their eyes open now. One teacher also said

that 'they're doing things that either they didn't do before or else I didn't notice them doing them before.' We couldn't decide whether it was because she was providing new ideas for them to explore or whether she hadn't looked at those clues in that light before.

Then they said that they wouldn't need to go through these special activities again. Before they couldn't relate the check-list statements to the children at all, and now they could do this and they are trying to match the children's activities to the development which they now see.

W. H. Yes, I can see that the check-list statements are not definite enough – they can't be, because you can't take in all the little situations which could give evidence about a particular aspect—but you found that to give *some* examples is necessary. The danger, of course, is that the examples then become a 'test' related to the check-list.

SR. ANNE We don't want a test. That's what we're trying to steer away from. But what I did want to do, and what they felt they needed to do was really to come to grips with these statements—what are they being asked for? and how can we find these clues? Because the materials that we gave to the children were the materials that they are handling in the classroom, and it's just a matter of suggestion that children place them in a certain position or you yourself move them, alter the position and ask, 'Am I changing it now? and how?' and lead them into discussion. We found that there was often confusion over certain words – for instance 'longer' to some children often meant 'higher' or 'lower'. We got around it eventually by saying things like this: 'Well supposing these are bars of chocolate and we put them like that. Would you mind which one I gave to you?' And then, 'If we put that one up there which one would you choose now?' Now the children who really thought that they had changed their length would say something like, 'This one, because it's bigger.' Except one little boy who said, 'This one, because my Mummy says I mustn't take the biggest!'

W. H. But that's lovely because you're struggling there to understand the child's way of looking at things, and this is exactly what we want. That's what I don't like about things like the Check-Ups because they seemed to give the teacher a formula to do things with the child and then to interpret what happened, regardless of whether the child was really understanding the situation. So I can see this sort of thing is very good here, but I'm wondering if

we can find a safe way of doing this kind of thing, giving this kind of help which teachers presumably need, as you find they do.

SR. ANNE

I don't know, because you see this has grown out of this particular situation, from a teacher saying, 'I can't apply the check-list because I really don't know what to look for.' She needed some very certain guide-lines. But at the same time we did it in a way that she was warned that these were not going to give the answers, but just to open her eyes, and she would have to look further and to listen more. This same teacher has said to me they do quite a bit at lunch-time—she's said, 'I make better observation of the children at lunch-time when they don't know that I'm listening to them.' The children who don't want to be in the playground can come in when she's been there and, although she's getting on with a job, she's listening too. The teachers do feel happier now, although we can't be absolutely sure even now that we really are reading the statements in the same way. You can't, there's always a chance of a variation between teachers.

And from that I went on to match the activities, taking things from the back of the guide we had written, but spelling it out a little more clearly. Saying if your child falls between this  and  for area, then it is worth while keeping to activities of these kinds [see example of notes on area below].

Then if they are moving from here to here,



start these activities here [given below], but remembering that they still need some of the earlier activities. Then if they're here  this is the time to start these things [see below].

This is personal to the school. I think every school would have to do this, because not all would like the way, for instance, that I've suggested for recording. This is one of the greatest problems of our teachers, 'How do the children record', and these ideas are not necessarily what would seem right to all teachers.

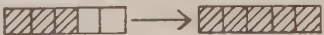
Example of the notes produced by Sr. Anne

to guide the teachers' 'matching' of activities involving 'area'.



1 Plenty of free play—domestic corner,

printing and painting,
collage work, junk,
jigsaw puzzles,
sewing,
use of variously shaped bricks.

During this period, child is developing an awareness of the 'spread' of a surface space. 

- 2 Recognizing and handling flat shapes—circles, squares, triangles, hexagons, rectangles. Look for these on the surface of solid shapes. Sorting according to shape. Collecting objects which have certain shapes in them. Printing with regular shapes—which shapes fit together. Use templates of shapes, cut out several of each in coloured sticky paper. Stick down to make repeated patterns. Incorporate this kind of activity in art work—e.g. collages and covering junk models with shapes in wallpaper.

Give some directed activities using shapes to cover surface of regular shapes—e.g. how many postcards are needed to cover the top of the table?

Using one unit, move it along repeatedly to find out how many times it will fit on top of a surface.

Eventually lead into selecting a square as the most convenient unit.



- 3 If this is arrived at, squared paper can be used and the surface of shapes measured in cm^2 by drawing around them on the paper.

At this stage, a child should be able to appreciate the differences between length, height, width, circumference, perimeter and area. Give practice in measuring all of these, using standard units.

Robin and Alistair observed

This account links together observations made of two children, Alistair 6 years and Robin rising 6, over a period of two terms. The observations picked out are those relating to one evolving piece of work; it must be stressed that many other observations in a variety of other contexts were made of these children and of the other children in their vertically grouped infants class during the same period. The work was not carried out only by Robin and Alistair, several other children slotted in when they were interested and moved away when their interest was exhausted.

Making light

Near the beginning of the Spring term the teacher put out on a table some wire, a bulb and a battery, and beside it a card: 'Can you make the bulb light up?' Alistair took up the challenge and after some time

made the bulb light up, purely by trial and error, touching wires in to one thing then another. As soon as it lit up he ran in excitement to tell his friend Robin and their immediate reaction was to say that they wanted to give a film show using the light.

From 'film' to shadows

The teacher did not fully understand what they meant by 'making a film' but later in the afternoon this became clear when she saw that they were trying to hold up pictures against the wall and shine the light onto them. By changing the pictures they hoped to give the effect of a film. But their first experiments were not very successful, for they were working in the classroom in broad daylight, trying to light up pictures on a white wall with a tiny bulb. They must have realized that the daylight was spoiling their efforts for they then went into the home bay, drew the curtains and began to work under a table. But it still was not dark enough for them and they came to the teacher to ask if they could work in the 'old cloakroom' where it was very dark.

The teacher was hesitant about letting the children out of sight, but since they seemed so keen to try out their ideas and were not likely just to 'mess about', she took them there and saw them settle down to work. Returning to them later she found that they had abandoned the drawings, since somehow they had discovered that they could make shadows on the wall. They began to experiment with casting shadows of toy cars on the wall.

A real moving film

Next day they pursued their work with shadows, in the old cloakroom. They attempted to make a paper boat as a shape for throwing shadows, but it would not stay upright, so Robin suggested using a toy engine, which the children called Ivor. Ivor was clock-work, but had to be pushed around because the key was lost. It must have been in doing this that they had to move the bulb out of the way at some point and noticed that moving the light caused the shadow to move. They reported this to the teacher: 'We found out that if we moved the bulb we could make the shadow of it move, but the actual train, that wasn't the shadow didn't move.' Robin explained, 'You see the bulb was going to different places on the train which makes the train, er, the picture of the train on the wall, move.' They also noticed this: 'What we couldn't do, we couldn't make the train go in the station because when we moved the bulb for it to come out, the station moved with it.' After some thought he added 'Now I come to think of it we could, because the station looks like it's moving when the train's going away from it—and then we could turn it round and make the bulb move the other way.'

Trying to colour shadows

Over the next few weeks the idea of making a film remained with the two boys and they each wrote a story about a train. This was Robin's story:*

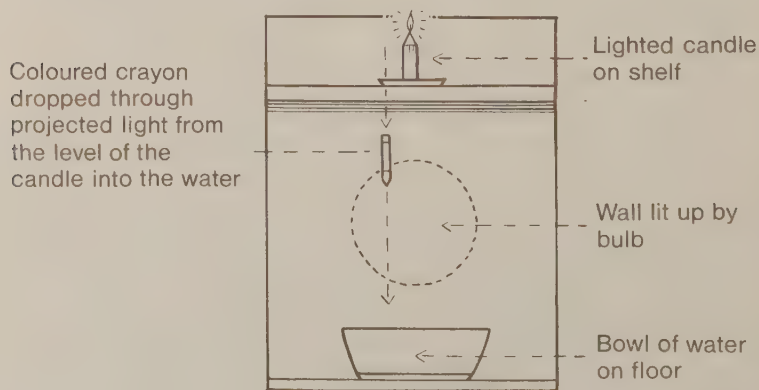
'Ivor is going to go round the tracks. He is going for an adventure. He goes into the woods. He is looking to see if there has been any coal dropped. He does find some, he does put it in his boiler. When he put it in he went faster, and he found a lot of coal. He ran out of coal. He couldn't go any more.'

Robin recorded the story on tape, something they were used to doing, and they worked out actions of the shadows to go with it. They found out how to make the engine seem bigger or smaller by moving the light.

The teacher offered them some 'train music' on tape as background for their film, but they rejected it, preferring to make their own sounds.

Ivor was a red engine, but the shadow was not coloured. This did not suit Robin, described by his teacher as being very colour conscious. They had an idea that they could make coloured light if they used a candle, a dish of water and some coloured crayons. It was difficult for the teacher to grasp what they were trying to do, but she said she would let them try. They had to wait until she had time to go down to the clockroom with them as they were not allowed to light the candle alone.

This is what they did:



The table with the light bulb and toy engine was placed just in front of this.

Alistair tried to explain that he was making colours like the ones he

* At about this time BBC TV children's programmes included a series of stories about a cartoon steam engine called Ivor. The engine was often 'looking for coal' in these stories and the theme of Robin's story was probably derived from this. Alistair, on the other hand, based his story very clearly on the railway books of the Rev. W. Awdry.

had seen in the sky in the evening. Living in a town with a broad river running through it, he had often seen the sun and evening sky reflected in the river. Perhaps he thought the river was throwing up colours into the sky. Trying to imitate this they placed the bowl of water on the floor, put the lighted candle high up on a shelf above, and projected the light on the wall just below the candle. Then they dropped the crayons past the 'screen' on the wall and hoped the water would reflect the colours onto the screen. It did not work. Alistair said 'Just a moment, we've just got the candle in the wrong place, let me move it over.' He lifted the candle from the shelf over the screen to a shelf at the side. His face lit up, he said, 'We've got two Ivors!' They quickly worked out that if two lights made two shadows, three lights would make three, 'We can have a junction!' The idea of technicolour was then forgotten and they went off to get more candles. For safety's sake this meant that the work could go on only when the teacher had time to stay with them.

Experimenting continued and they consolidated their ideas about changing the size of the shadow and making things appear to move relative to one another. 'For three trains we have to have three candles or three batteries and bulbs. When we moved the thing nearer then it got very, very big and when we put it further away it got smaller and smaller.'

The film show

At the end of the Spring term they showed their 'film' to other children in the class. The show was given under a table and the children crowding round shaded the wall beneath. It took about 20 minutes for the performance, during which time the children sat squashed under the table. The show broke down several times but there was no complaint or loss of attention from the audience. The teacher noted how this contrasted with their behaviour when she tells the class a story; any interruption giving rise to fidgeting right away. In this case their attention held.

During the course of the term's work some other children had joined in for short periods and had been allowed to try things out, but none had sustained interest for as long as Robin and Alistair. One child, Julian, previously very friendly with Alistair had been clearly jealous of the time the latter was spending with Robin. He began to interfere rather destructively, but was treated very patiently by Robin.

A large-scale Ivor

Before the end of term they asked if they could do something else with Ivor, and the teacher suggested they might make a model of the engine.

They wanted it to be large enough for them to sit in and so started by glueing cardboard boxes together and painting the whole red. The project continued in the following term, the teacher leaving the initiative to the children.

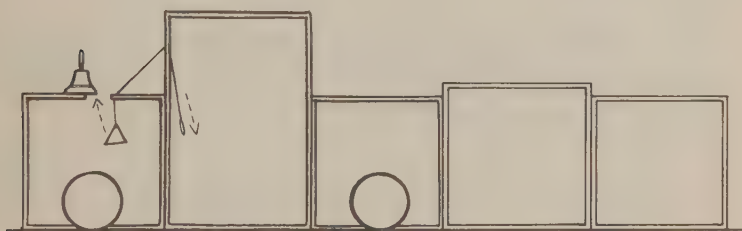
They had lots of ideas about their model. They wanted to give rides in it, so it had to have wheels. They started by making the wheels from plastic carton tops. They found it was difficult to glue these on; glue would not stick to the plastic and neither would the paint. They mixed glue with paint and experimented for some time to see if this would work. Then there was the problem of attaching the wheels. They did not really want them stuck on because they would not move round, so they tried putting a stick through the centre and pushing the other end into the model. They were unsuccessful in attempting to make the wheels move by tying elastic bands round them. In any case the wheels kept coming off. Eventually they asked for help from a girl who used a needle and thread to go through the cardboard and plastic wheel, through a bead and back again. With no axles the wheels were not able to support the train and were attached with their lower edges level with the base of the boxes. They still had hopes of moving the train, however.

Daniel's notice—smoke and steam

One day Daniel was bitten by the hamster. He said there should have been a notice up to say that people should not put their hands in the cage. After the teacher wrote a notice to this effect Daniel wanted to put up another notice 'No smoking'. Another child suggested the notice should be put on Ivor because trains do have such notices. Alistair and Robin said it could not go on Ivor because he was a steam train and had to smoke. Soon they agreed it could be put on for the passengers, but the discussion of Ivor's smoking brought up the subject of how the engine worked. Alistair was quite sure that there were three ways, all using electricity: 'Sometimes there's a very powerful engine that makes the electricity go very hot through a wire and it goes into a water tank and the water boils and changes into steam that pushes the pistons [later corrected by teacher] that make the wheels go round so that it goes along the track . . . Well, um, another one is, um, there's an electric motor at the end of the rails and the wire from the motor goes up on the pole and over the tracks, and, um, the trains have a little pole that gets electricity on and goes down and it goes into the water and it boils it as well, then the same thing happens after that. The third way is they use four yellow batteries instead of an engine, the same works after that.' He was sure this information was right because he'd found it in a 'train book at home'. He went on to volunteer the information that 'Mr Watt discovered steam engines', and that steam is 'very boiling water'.

Ivor's bell

A small hand bell was found for Ivor and was first suspended inside the box which was the driver's cabin. It was not loud enough and in any case, as Robin said, 'Proper trains have the bell outside, they don't have it inside,' so on Alistair's suggestion they made a hole in the top of the box and placed the bell over this. Beneath the hole a triangle was suspended from string. From the driver's cabin this could be pulled, bringing up the triangle to strike the bell. The triangle was chosen to strike the bell after trying various other objects; nothing else gave quite such a satisfactory noise.



Lights

One of their greatest problems was the lights. They wanted a light outside on the front of the train and one in the driver's cabin as well. There was only one battery for the two bulbs. Their first idea was to connect each side of the battery to one bulb.



The teacher gave them a spare piece of wire and suggested they might try using it. They could not see any use for it and instead turned their attention to the bulb holders. A screw was missing, and Robin said this was why the bulb did not light. The teacher pointed out that the missing screw had not prevented the bulb lighting previously, and again drew attention to the extra wire. Again they ignored it and Robin instead had the idea of cutting off more plastic from the end of the wire and dividing the strands between the two connections to the bulb!



They tried other things but none worked. Eventually they cut a hole in the driver's cabin so that one bulb in there would provide a light both inside and out.

Other work developing from the interest created by the project and shared by other children, included:

- shadow tracing in the playground,
- shadow clocks, using a netball post and the children themselves,
- reflecting light from mirrors,
- creative writing and modelling,
- making colour wheels.

Notes made by the teacher relating to items in the check list

(NB. Her closer observation of each child's behaviour enabled her to make notes about each child separately -here we are not able to do this and treat them as a pair.)

Curiosity

- Alistair wanting to make the bulbs light in the beginning.
- Noticed things which they did not expect, e.g. shadows moving and changing in size. Sought by action to find out the cause, but did not really give a satisfactory explanation.
- Did not ask many questions of teacher, but often did of each other.
- Switched interest from one thing to another, e.g. from making coloured film to using several light sources.

Originality

- Their idea to make a film.
- Preferred their own sound effects to ready-made 'train music'.
- Alistair's solution to the problem of making the bell ring from inside the cab.
- Ideas for making the train move using elastic bands.

Willingness to co-operate

- Helped to try each other's ideas.
- Tolerated interference from Julian.
- Allowed other children to join in and leave as they wished.

Perseverance

- Finding a place where their 'film' would show up.
- Fixing wheels so that they rotated.
- Continuing the work over two terms.

Open-mindedness

- Listened to other points of view about the 'No Smoking' sign.
- Accepted idea of writing a story for the film.

Self-criticism

- Made frequent changes and repairs to model.

Responsibility

- Worked in cloakroom without constant supervision.
- Brought a lot of the materials they needed for model.

Independence in thinking

- Made up own minds about the type of model, size and rotation of wheels, etc.
- Alistair stuck to his ideas about steam engines working from electricity.

Observing

- Alistair's observation of the sunset.
- Details on toy engine which they tried to reproduce on their model.

Problem solving

- Mostly by trial and error, e.g. putting on the wheels, trying to paint the wheels, light the bulbs.
- Thought out how to make bell ring outside cab.
- Found own solution to light problem on the model.

Raising questions

- How can we make a colour film?
- How can the bell be made to ring?
- How can we have a light inside and outside?
- These and other questions pursued to their own satisfaction.

Exploring

- How to make light from bulb show up in daylight.
- Finding out the effect of moving the light.
- Ways of making paint stick on plastic wheels.
- Trying out ideas about making coloured light.

Finding patterns in observations

- Two lights—two shadows, three lights—three shadows.
- Noticing the effect of the light's position on the size of the shadow.

Communicating verbally

- Ideas expressed orally quite clearly, though not always easy to understand without seeing what they were doing.
- Explained things well enough to other children to hold their attention.
- Use of books for information.

Communicating non-verbally

Used their model and its shadow to act out the story.

Applying learning

- Attempted to apply observation of coloured lights in sky to making 'technicolour'.

Cause and effect

- Made bulb light by trial and error; had little idea of 'complete circuit' as shown by failure to light two bulbs.
- 'Explanation' of steam engine; causal links only vaguely recognized. Making coloured light with the crayons; components there but no idea of process.
- Making a 'film' with picture and light.
- Screws thought to be responsible for bulb not lighting.

<i>Classification</i>	} Too little evidence here.
<i>Weight</i>	
<i>Length</i>	
<i>Area</i>	
<i>Volume</i>	
<i>Time</i>	

A Summary of Piagetian Stages

The Pre-operational stage

Although we are not giving much attention to the stage which precedes this it is useful to consider very briefly the main feature of the sensorimotor stage in order to see the foundations for the pre-operational stage and the advances which have been made.

In the sensorimotor stage the child has no language or other means of symbolizing objects and there is no evidence of the mental activity which is called 'thinking'. Action takes the place of thought; he has discovered many things about his surroundings by direct action and the co-ordination of actions achieved during the first two years. The end of this stage marks the beginning of ability to manipulate things symbolically and not just by direct action. The development of language provides symbols to represent objects, and throughout the pre-operational stage there is an increasing ability to distinguish the word from the thing it represents. As he masters words he can talk and think about objects instead of only acting on them, and there is the beginning of the reconstruction in thought of skills and knowledge which were previously discovered through direct action. But only the beginning, since the representation in thought of some actions develops only slowly, and here we find Piaget's reason for describing the stage as *pre-operational*.

For Piaget an 'operation' is an action which is internalized, carried out in thought. It is also a particular kind of action which is reversible, that is, can be carried out in opposite directions, as is the case of a journey which can be carried out from start to finish and back again. Adding and subtracting are two parts of a reversible mathematical operation

add 2 to 5 → 7
take 2 from 7 → 5, back to where you started.

In the pre-operational stage this kind of process cannot be carried out mentally, and this has many important consequences for the thinking which can take place. One of the most obvious, which Piaget demonstrated very clearly, is the absence of conservation of quantity. If a liquid is poured from a tall narrow container to a short wider one the child will claim that there is more liquid when it is in one container than the other. If he judges from the depth he will say there was more in the narrower container; if he notices the cross-section, he will claim there is more in the wider one. The child cannot imagine the liquid being poured back nor argue from the fact that nothing has been added or taken away that it must be the same — this is lack of reversibility.

The lack of reversibility of thought and consideration of only one aspect at a time, is connected with another feature of thinking in this stage, that the child has but one point of view only — his own. He sees the world as it looks to him and cannot envisage a different viewpoint. He communicates to others in terms which assume everyone else shares his thoughts and point of view, and is surprised to find that he is not understood. This becomes immediately obvious if a young child is trying to show another how to do something.

The selective attention given to one feature or another has already been mentioned in relation to judging the effect of pouring water. It also shows in inability to place various parts of a process in sequence. The initial and final states can be recognized but not the stages in between. After watching sand run through a timer, David, at six, could draw how it looked at the beginning and at the end but not in between, nor could he arrange five drawings of the timer in the correct order to represent the sequence as the sand ran out, except for the first and last ones. It seems that in this stage the most obvious impressions, the slow or motionless states, are registered in preference to the changing and less obvious ones.

When only the beginning and end of an action are noticed and there seems to be no grasp of the process as a whole, it is not surprising that a child at the pre-operational stage cannot anticipate the effect of certain changes. He is unable to think through the action to find out what will happen — he has to *do* it. Watching children play board games where they are moving counters or draughts gives many examples of this. On one such occasion six-year-old Pauline playing chess was not worried that her opponent could take her pawn — 'It's all right, I'll be able to take his next time' she said, not realizing the pawn she expected to be able to use would by then be removed.

Ideas about cause and effect are also far from logical. An object or component can 'cause' something to happen just by being present, whether or not there could possibly be any link with whatever it is supposed to cause.

We can see that the features of pre-operational thinking which have been mentioned are all connected together — lack of reversibility has

much in common with inability to see how one step in a sequence of change must come before another, and this in turn is linked with the absence of logical ideas about cause and effect. There are many other features which have not been mentioned and these too are closely related to the same general theme. This theme represents pre-operational thought as able to *represent* real things and act on them, but less able to manipulate them or mentally perform actions which have not actually been performed. If we look at the broad picture of the stage in these terms we see that the one-sidedness of thought, the lack of awareness of others' points of view, the absence of logical ideas about cause and effect and of reversibility of thought, are all aspects of inability to *think* an action.

What this can mean in practice is illustrated by an event in a family-grouped infants' class. A television programme in mathematics led to a discussion of the pros and cons of measuring length in arbitrary units. They agreed that measuring the length of the room in paces led to different answers. 'Who would have the greatest number of paces, a person with the longest legs or the shortest legs?' asked the teacher. Some replied with the right answer but some were sure that 'longest' would go with 'most'. The teacher found no help in asking them to *think* out what would happen when the room was paced with long legs and then with short legs, for this was asking the children to do what pre-operational thinkers are unable to do—carry out actions in thought. Instead they had to carry out the actions in practice, so long and short legged pupils duly paced the room.

The concrete operational stage

Each stage in Piaget's description represents some significant advance in thinking over the one which went before. For the pre-operational stage this major advance was ability to represent objects and actions mentally instead of knowing about them only through direct action, as in the sensorimotor stage. The major limitations of the pre-operational stage were the inability to grasp a process as a whole and to think through actions which had not actually been performed. In the concrete operational stage the important advance is the removal of these limitations; it is the stage in which representations are brought together and related to each other so that a process of change, and its reverse, can be envisaged. The child develops systems for organizing his thoughts and manipulating things mentally; he becomes able to think through problems, and does this in a way which has much in common with certain rules of logic.

Before going into what is meant by these systems of thought we should be clear about the word 'concrete'. In this context it refers to things which a person can perceive in the world around. Concrete things

are not necessarily those with which the child himself has had first hand contact, but they are ones which are real and which he knows through one or more of his senses can exist. So things seen on television, read or told about are concrete, in distinction from abstract ideas (four dimensional space, for instance), hypothetical notions or purely verbal arguments. So in this stage the operations—actions carried out mentally—are limited to manipulation of things which can be envisaged in the mind.

So what are the operations, the systems of mental actions which can be carried out at this stage? There are many and we can give only a few examples: adding and subtracting and other numerical operations; measuring; putting things in a series; putting them together in groups to form a classification. In all these the action is reversible, either in the way that addition cancels subtraction or in the way that relationships are reciprocal—if A is greater than B, then B must be less than A.

It is this reversibility in thinking an action which accounts to a large extent for one of the main advances of this stage—ideas about conservation of various quantities. When changes are made which make a quantity look different, as when a liquid is poured from one container to another of different shape, the child is no longer guided only by appearances as he was as a pre-operational thinker. Instead he can, as it were, mentally reverse the change, and his reasoning that nothing can have changed contradicts what he sees. The change to conservation does not come about suddenly, of course, but takes place gradually, more quickly in the cases where the immediate impression can be easily contradicted by thought than where appearances strongly contradict the thinking. So it is not surprising that conservation of length, where there is only one dimension to consider, appears before that of area or volume where changes can affect more than one dimension and can be much more striking.

Sarah (seven) gave a good example of conserving quantity but not weight when she was rolling out pastry for making jam tarts. Her teacher took the opportunity to find out what Sarah thought was happening to the total amount of pastry as it was spread out more and more. Did she think there was any more pastry after she had finished rolling than before? 'No, it's the same, it just gets thinner' she said. What about when the tarts were cut out and the pastry was in pieces? 'Well, it's still the same pastry as before because we haven't made any more or taken bits away.' After cooking the tarts had risen, and they talked about the difference in size. Sarah explained that this was 'because the pieces have moved apart in the cooking: it's not really any more.' When asked if anything had changed she said, 'Yes I think they must be heavier, because they're bigger.'

Sarah was at the beginning of concrete operational thinking and gradually the thinking which enabled her to deny that what looked more was necessarily more, would be extended to more complex

situations. Another ability which develops at the same time relates to handling variables. Sarah realized that the area of the pastry was not the only thing to consider, and was implicitly compensating for the increase in one variable, the area, by decrease in another, the thickness. This is in contrast to the pre-operational thinker who would look at either the thickness or the area and judge from one, ignoring the change in the other. But the number of variables which can be manipulated in this way is limited and it is not until the next stage, of formal operational thinking, that a complete system of operations for manipulating variables is achieved.

One of the striking characteristics of pre-operational thought was its one-sidedness—everything seen by the child from his own viewpoint only. Throughout the concrete operational stage there is a progressive change towards being able to take another's point of view. It shows in the child's ability to co-operate, to share things in an understanding of others' needs and responsibilities, and in his ability to communicate in a way which is likely to be understood by others. Pre-operational children talk more for themselves than for others, but at this next stage the actions which can be carried out in thought include changing his viewpoint to that of another person, and making allowances for others not thinking in the same way or having the same experience as him.

Reasoning about cause and effect is also of a different kind than was found before. Previously physical causes were not distinguished from intentions—an infant-age child would say that a toy dangling on the end of a string twists round 'because the string wants to untwist itself'. During the concrete operational stage the child becomes able to distinguish an intention from a physical cause, though he still has difficulties in relating ideas or statements where one follows logically from another.

Now that we have seen some of the strengths of this stage of thinking as compared with the previous one we should complete the picture by considering some of its limitations. We have already hinted at some of them, in relation to dealing with variables and cause and effect relationships which, like other limitations, stem from the preoccupation of thought at this stage with what can be perceived through the senses. The concrete, the here-and-now, the actual rather than the possible, are the limits of thinking. In practice this means that abstract ideas cannot easily be grasped, if at all, and problems which can be solved in a concrete form cannot be tackled if presented in terms of a generalization. For instance an eleven year old can show for a *particular* right-angled triangle that the square of the sides meeting at the right angle is equal to the square on the third side, but he is unlikely to be able to prove that the relationship holds for all right-angled triangles. Drawing conclusions requires some abstraction and it is not easy for the child to make a generalization from what he observes, other than a sweeping statement which is not justified by the evidence.

It is also difficult for him to imagine conditions or situations which do not actually exist and to reason about what might happen. For example, when Mark and Guy were studying a model of the solar system their teacher asked them if they could think what difference we would find if the axis of rotation of the earth were not tilted. Mark was unable to attempt the problem because, as he said, 'It always is tilted so you'd never know'. Guy made a reasonable suggestion and then seemed to warm to playing with ideas of 'what if' and threw in for good measure the observation that if the earth were to spin the opposite way the sun would rise in the West and set in the East. In this instance, at least, Guy was showing signs of transition to formal operational thinking where ideas can be tested out in thought and not only in practice.

Towards formal operational thinking

Up to the age of thirteen very few children reach the stage of formal operational thought, but many will be beginning the transition to it, so it is more appropriate to give attention to the signs of this transition than to consider the abilities which are fully developed when the stage is reached. It helps us, though, in describing the transition if we know the point from which it starts and the kind of thinking to which it will lead.

To illustrate the difference between concrete operational and formal operational thinking, it is enough to take just a few examples. The concrete thinker is able to carry out operations, that is to manipulate in his mind, things which have reality for him, but the formal thinker can carry out operations on operations, that is, on concepts arrived at through thinking. For instance, explaining the floating or sinking of an object in a liquid in terms of the ratio between its mass and volume as compared with the same ratio for the liquid, seems to be possible only at the formal thinking stage. The concepts of mass and of volume are formed during the concrete stage, but forming the concept of the ratio of one to the other only comes later. Thus a true grasp of density, as in the case of other concepts which are derived from concepts—pressure, work and power, for example—requires some degree of formal thinking. In the transition period it is likely that a restricted idea of density would be used to explain a particular case but would not be generalized into a rule applying to all objects and liquids.

The word 'formal' gives a clue to another distinction; the concrete operational thinker is concerned more with the immediate use of an object or feature and less with the reason for its form. 'Ducks have webbed feet to help them swim' is typical of the concrete thinker whilst the formal thinker is more likely to make a statement in terms of the form of the duck's feet being suited to its habitat. The same sort of difference is found in considering arguments or logical reasoning; for example, ask a child what is wrong with this reasoning: 'All cows

eat grass. This animal eats grass. It must be a cow'? A concrete operational thinker responds to the content, saying something like 'But there are other animals besides cows that eat grass,' whilst only the formal operational thinker will explain that the form of the statement, 'All cows eat grass,' does not mean the same as 'all grass is eaten by cows.' There are many examples where this kind of reasoning is required; for instance, in formal proofs in geometry or in science, and the 'rules' of learning a foreign language, or of spelling in English. It is generally acknowledged that tasks which demand such reasoning are best delayed to the secondary years where pupils are more likely to have developed the kind of thinking demanded, and in the primary and middle years to gather experience directly, learning spelling and language by usage and describing, rather than attempting a generalized explanation of what is found in maths and science.

The formal operational thinker differs from the concrete thinker in being more able to think about the abstract, to consider what is not in fact a reality but only a possibility. He is better able to entertain ideas about what might happen in the future or could happen in a hypothetical present. There is a time when the adolescent seems drunk with this new ability to consider what might be—he is naively idealistic and has too great a faith in the power of his thoughts, which take on the character of dreams of transforming the world.

In the transition to the formal stage, however, the greater ability to handle possibilities instead of actualities shows in the way problems are approached and possible solutions tested out. A concrete thinker argues from what can be observed, and tests out ideas as they occur to him, whilst a child at the later stage is capable of considering what are the possibilities in a situation and working systematically to eliminate all but the solution which is found to apply. It is possible to see a pattern here from pre-operational to formal operational thinking: the pre-operational child gives attention to only one aspect of a problem ignoring others which are there to be seen; the concrete operational child considers the various aspects which can be observed, but he has a limited ability to combine them to find a solution; at the next stage the child can take into account factors which are not directly observable and test out the possible combinations systematically.

It is not only in relation to physical problems that thought reaches a higher level than the concrete. Progress in ability to envisage a variety of different points of view continues, and the individual is able to see himself as one among many, his opinion as *one* opinion not *the only one*, and he is able to be more objective in his judgements. For example when a group of thirteen-year-old girls produced a shadow puppet play they had to decide who was to be the narrator. They explained how this was done. 'We tried out various voices until we hit on the one which seemed to be the best. It just happened to be Marion's.' So Marion was the speaker by agreement. Had they been less mature they may only

have agreed providing each was able to have a turn as speaker, or if Marion's role was cut down in some other respect 'to make it fair'. Less mature still (at the pre-operational stage) it is likely that an adult would have had to initiate the 'agreement' and to supervise strict fairness in terms of participation of each child. The older girls considered the good of the play rather than only their own part in it.

Having seen some of the ways in which formal thinking differs from the earlier stage, we must remember that what we shall find in children up to 13 years, at most, are signs of transition. Such signs were shown by Richard when he was criticizing the results of a poll he and his friend had carried out about preference for various school dinner menus. 'We might just have happened to choose the ones who like fish and chips. In any case we only gave them six to choose from, and there might have been other things they liked better than any of them. We ought to do it again with different children.'

From lungs to syphons

The following discussion among a group of primary and secondary teachers arose from considering the first of the problems presented on page 165. It may be useful to those who do not have the benefit of access to others' ideas and alternative suggestions as a basis for reflecting upon their own response.

- MR. J. Clearly there is a whole variety of responses. In the first one the teacher might say, well, great, we might take off and have a series of enquiries about syphoning, but remember that this investigation was really about lungs. In other words, the context is important. Do you allow a serendipity to take over and become the guiding principle? And what is the fine dividing line between saying 'there's something very interesting happening here, but we'll take it up later,' and thinking that the context makes it more important to pursue the new enquiry and get back to the original problem later? There are other alternatives, too, such as 'Why are you mucking about?'
- MRS. W. Presumably the first thing the teacher would have to do is to find out why the children are doing what they are doing, rather than going along and saying 'You shouldn't be doing this, but that.'
- MR. N. Or 'In what way do you see what you're doing is helping to provide some answer to your original question?' I mean, what has syphoning got to do with what you are trying to find out.
- MRS. W. Well, it probably hasn't got much. But there might still be a good reason for doing it, they might have completed what they were doing and feel that they've done enough, and 'Let's use this for something more interesting.'

MR. N. Well, it's an essential part of science education that children shall see that what they propose to do holds out some prospect of answering the question, and preferably of answering it in the simplest way possible and not the most complex, and they should be made to think about this. In this particular case, they're trying to find out how much air they can blow out of their lungs. . .

MRS. W. They were . . .

MR. N. Yes, they've shifted off to something quite different now. But it came from them, it wasn't imposed on them; then I think they ought to be made to sit down and explain why they thought what they were now doing had anything to do with their original problem, and if it hadn't, why they were doing this rather than something which they thought had some relevance.

MRS. W. But may be they didn't see any connection or didn't intend any connection.

MR. N. But they did ask the question . . .

MRS. W. In this situation you have to leave a group for often half an hour, and if in that time . . .

MR. N. . . if they've taken a problem abroad they have to learn—this is perseverance, and all sorts of things—

MRS. W. But they're only eleven years old!

MR. N. I'm taking the other point of view—at that age—

MR. J. There's something very fundamental here, the point is are they now 'mucking about'? You see, it's made respectable in this account by saying that they're really beginning now—this is what we're invited to accept—the investigation of another physical phenomenon called syphoning, which is the basis of another enquiry. But they started on one enquiry which they may not have completed, they've now gone off on another enquiry which they may not in any sense fully understand, and there are occasions where you would describe this as 'mucking about'. Because it's not syphoning. It's where you've taken them out to see a pond and they become interested in whether their 'wellies' stick in the mud. . .

MRS. W. But surely what you should do in all these cases is to find out which is operating, to investigate the situation. I'm afraid this is not what many teachers would do; they would come up and say 'Stop mucking up and get on with it.'

MR. D. But there's also an element in science which is discipline, discipline within the science. This is something the kids have got to learn, too, that when they're pursuing an enquiry they must pursue that enquiry to get something out of it.

MR. J. Do you find that? I normally start off investigating one problem and invariably end up investigating a rather different

problem. And I would have thought this was normal sort of experience. So it could be a case of this, the kids started off on one problem and they shifted the problem.

MR. B. I think you've got to bear in mind that it isn't a case of majority rule. But if you have got a class of 35 or so and one comes up with one little thing you've also got to consider in your mind 'I know this is interesting, but the others are all working busily on the original problem, where is the balance of advantage?' This isn't something you can lay down, you've got to look at it. If half the class is interested or more than half the class then there may be a case for pursuing it. Alternatively there may be a case for saying, 'That's fine but let's finish this first then we'll come back to it.'

MRS. W. But the interest may not be there when you come back to it.

MR. N. Well in that case you're not educating them properly if their interest is as ephemeral as all that. If they either do it at the time they want to do it or won't do it at all then this is one of the evils we're suffering from. And so science is not being used as a vehicle for education if you get that kind of attitude across.

MR. J. You see, I'm intrigued by the contrast between these two approaches, on the one hand the notion that lots of scientific enquiries do start off by pursuing one kind of problem and genuinely go on to another one. This happens, though not as often as people think, but it does happen. On the other hand you've got the context in which these kids changed direction. If, for example, that teacher had set up the lung enquiry properly there would have been another group, quite likely, actually with a set of sheep's lungs blowing them up...

MRS. W. ... Ah, in a secondary class, perhaps, but in a primary classroom you've only got one sink, remember, and the rest would be doing some maths, some art and some reading, because you can't have the whole of them working together on the one thing...

MR. J. ... I don't see why they shouldn't all be working on different aspects of the same thing, what's wrong with that?

MR. B. The limitations of apparatus available usually.

MRS. L. I think we have to study the age of the children and the stage of the children; you can't really give an answer to this problem. It really depends completely upon the type of children, the situation, what they've done before, what they're going to do in the future and I think the teacher's got to decide there and then—this is one of the skills of the teacher, to decide what action to take in this particular situation.

MR. J. Yes, you see the syphoning thing may not show lack of interest at all. It may be their equivalent of a coffee break.

After all we'll work for a certain period of time, go off at break and do something else and return to the problem. May be the kids got stuck and thought, you know, we'll leave it alone for a while, do something else and come back to it later.

MR. N. I still think the teacher really ought to get the children to make the connection between what they're now doing and the problem they said they were wanting to tackle. Even if the teacher knows there is no connection, but if they feel there is one, then I'd say let them go on and explore what it is with their syphons, but always to have in mind the basic problem they're trying to tackle. I think that dragging in the way some researchers shift from one problem to another is not really fair. This is a different situation—in research you find there's some area of knowledge which now is missing, you can't take the next step until something is filled in so you go off and try to fill it in. Or you find that, arising out of something you've been doing that you go off on another trail. But my question would be, 'Did the syphon work arise out of the problem they were tackling?' If it doesn't then they should leave the syphon to another time and carry on solving the problem they started with.

MRS. L. Would you say that applies to my five and six year olds? They'd find something which is nothing what so ever to do with it and say 'Good, isn't it lovely, isn't it exciting'—er—how can you apply that to them to say 'You started off with so and so...'

MR. N. Yes, I think so...

MRS. W. But how do we know whether or not there is a connection in their minds?

MR. N. Well, I say if *they* can make a connection. I would ask them to say what is the connection. I've said this. However we may say in our superior wisdom, that it'll turn out not to be connected. If they say they see a connection between what they're doing and the problem they set out to tackle then let them do it. But if they say no, then either they've chosen a bad problem...

MRS. W. But are you going to judge whether the connection they see is a good one? Suppose it's just that the pipe was there and the water was there.

MR. N. No I don't think so, because it's not associated with what they thought they were trying to do.

MRS. W. So really your judgement about what is a connection is coming into it.

MR. N. No. If the only connection is the materials they're using, not that they can see how they're using the materials might give them some clue—that's the difference.

- MRS. W. It's a bit borderline, isn't it?
- MR. B. I think the whole thing depends on the age of the children you're dealing with and also the number of children . . .
- MR. N. But these are eleven year olds. You have to come back to that. I'm talking in terms of eleven year olds, because this is what it says.
- MRS. L. Do you think I should say it to my five year old?
- MR. N. Well, I think I should, but I wouldn't choose this—I mean if they were tackling this kind of thing I'd be quite happy if they said they'd like to find out if the moon's really made of green cheese—but these are eleven year olds.

Progress towards method C (see page 144)

by Sister Anne Darwin, Sacred Heart R.C. Primary School, Henley-on-Thames.

I recognized the value of child-centred learning—by which I mean taking my cues from the interests and ideas of the children rather than my own pre-planned programme several years ago, but adopting it as a general practice in my teaching has been a very gradual process, which is still going on. It has been largely influenced by the following factors:

- (a) Growth of experience in classroom management and organization.
- (b) Deepening my personal understanding of how children think and react.
- (c) A constant effort made to build up good relationships with the children.
- (d) Steady involvement of parents.

Before saying more about these points I must stress that without the support of my Head Teachers and other colleagues during this time I feel very little could have been done.

(a) Growth in classroom management and organization

As my confidence developed, the organization of my teaching has so far passed through these stages:

- 1 Group work, with '3 Rs' in the morning and creative work in the afternoon. This gradually gave way to a more flexible time-table but the children were still kept in groups, formed according to ability. A record of *class* work was kept.
- 2 Bit by bit an integrated day was introduced. The children then started to work at their own pace and were catered for as individuals. It was evidently necessary to keep records for each child individually. Work was still largely teacher-directed.
- 3 A move was then made towards co-operating with another teacher. My class joined hers in one large room. I took full responsibility for all the creative and maths work and she did the same for reading, writing and language skills. For the first time in my teaching experience, I was able to share observations made of the children with another member of staff who was equally involved

in the work as I. By the end of the first year we agreed that because our work was limited to certain areas of learning we failed to get an honest picture of the overall development of each child and so we prepared for a further change.

- 4 Co-operative teaching of another kind was started. Whilst sharing the same teaching area we took the full responsibility for our group of children. Exchanging ideas about children's behaviour and learning, watching them closely and listening to them had opened my eyes to their interests, and gradually I allowed myself to be led by these interests so that they became central to my teaching. In other words I began to make a policy of giving the children the chance to become immersed in a self-chosen activity before stepping in and using this as a starting point for learning. Of course whilst applying this method, I am beginning to learn the art of recognizing how far an interest *can* be extended without killing it.

(b) Deepening my personal understanding of how children think and react.

This being brought about by careful observation, exchanging ideas with other teachers, following courses and reading.

(c) A constant effort made to build up good relationships with the children

This has involved taking time to *listen* to them, making the effort to join in their games sometimes, even if it is only a matter of turning the rope for a group who are skipping, or watching a game of football. Above all I have had to learn how to react sympathetically to their problems even if these seem trivial in adult eyes. Children have shown me that they value praise which is well earned and correction which is justly given, but they resent harsh and impulsive punishments. Before a child can openly share his interests with me, I need his trust.

(d) Steady involvement of parents

It has been absolutely essential for the children's security to keep the parents involved as much as possible. In this way expectations from home harmonize with provisions made in school.

Although for most of the day the children are now involved in activities which they feel are their own and which I support and use as avenues to learning, there are certain skills which I believe require direct teaching and for these the children are often taken together and taught in groups. Such skills include handwriting, movement, and the art of listening which is developed in groups through story, poetry, music and discussions.

In my effort to provide for individual needs I sometimes find children who lack security if given too much freedom and choice all at once. These children look constantly for direction from me, which I don't hesitate to give where I think it is really necessary; but I do make an effort to build up the confidence of these children and gently encourage them to become independent.

Another teacher recalled:

I suppose I began to change from the traditional teacher-directed approach almost in desperation. For several years I had successfully managed to 'train' my class to fit into my pattern and do what I wanted them to do, but then I had a boy who would not be trained. Julian was quite the most untrainable child you can imagine; he never seemed to want to do what the rest were doing and it took concentrated attention to keep him at his maths or English, or at least not disturbing the others. He loved painting and drawing, though, and would become absorbed in this as in no other activity. One day I was settling the class down to some maths and becoming aware of the normal signs of impending disruption from Julian, and I said to him 'Would you like to carry on with your picture now and do some maths later?' Of course he did prefer this and it was surprising to me how willingly he did do his maths later. So I began to give others the chance to pursue something of their own instead of all doing the same, always on the understanding that they did the 'basic' work at another time.

It didn't occur to me to plan alternatives for them because they only took up the option to do something else if they already had ideas about what they wanted to do. At first their starting points were found in the work we had done together, but one thing led to another and eventually quite fresh work was being started. I felt that they were so involved in the work which began this way that they would tackle far harder problems and difficulties of looking things up than in the normal run of events. The bits and pieces which were gathered together for the work of the ones who were first to have ideas soon attracted the less adventurous and they were all drawn into the work at some time or another.

They still had to do their basic work, just as my present class does, but somehow I feel this is done more willingly because they have responsibility for planning when to do it, rather than having it thrust on them at the time it suits me. It's having something of their own which has made the difference, I feel, and I must say that it shows many children in a new light. It gives them the chance to show me what they can do outside the bounds of the work I set. I learn a lot about them in these situations which gives me more ideas about how to help them in their basic work.

Starting from children's interests— examples from a vertically grouped infants' class

Louise, who is nearly 7, brought a caterpillar to school. But she said that when she found it it was a pupa. Stephen queried this strongly. Louise still insisted it was a pupa which had turned into a caterpillar. The teacher put the problem to the rest of the children and they suggested many explanations as to how Louise could have made a mistake, or what it was that made her think it was a pupa before it was a caterpillar. Some of the suggestions were that perhaps she saw a lump of mud, she might have seen a stick, she might have seen a pupa and a caterpillar together, and one child actually said 'Perhaps her Dad swopped it'. Louise and Stephen, still not satisfied with any explana-

tions, were determined to find out which one of them was right, and to see if the caterpillar could turn into a pupa. They went to all the teachers in the school and asked them. The teachers all offered explanations but Louise wouldn't accept them. She came back to her own teacher to ask for help in finding out. The teacher then found a house for the caterpillar and the children found the right food and they awaited events. Later on the caterpillar turned into a chrysalis and then into a moth and flew off. During this time the children studied books about the life cycle and they could identify the moth.

On another occasion the children had been looking at the goldfish in the glass tank. Now the children knew there were only three goldfish there but they wanted to know why, when they looked at a certain angle they could actually see six. This led to a project on reflection.

Two children decided they wanted to make an airport. They decided themselves what materials they would need; for example, the control tower was made of boxes, the helicopter was made of Lego, and the aeroplanes from balsa wood. The two children decided whom they would like to help them. They also discussed amongst themselves how they were going to do it and what each of them would do. In this case they contacted the teacher only if they needed help, or in fact if they got stuck with something and did not know how to proceed.

The organization of science activities

Science within a topic:

work of the first-year group in a Middle School

The following is transcribed from a tape recording in which the year leader describes how science is brought into topic work. The five first-year teachers work as a team, sharing resources, and with children able to move freely between rooms though based in one particular class.

'We started with a topic on the sea and we tried to link in most of our work - English work, science work -connected with the sea. It was linked in together, we didn't say "Now we're going to do science." The children started with their own ideas and their own thoughts about what they wanted to discover, and we sort of led them into a scientific way of thinking, and then they sorted out their own experiments—it was based very much on experimenting on the beach and they took their equipment with them down to the beach. They did the experiment, came back, and carried on with it in class.

'With other topics there has been less of a science bias in it. The last one was on the region round the school. Again we based the work on experiment and we tried to make sure that every child did some sort of experiment within his own topic. Usually there were experiments they thought up connected with their own interest, because they've got so many things they

could take up. "I could do that," or "I could do that," they're very divergent. They usually thought up their own. There were a few that you had to push and give them ideas.

"We had definite ideas in mind about some of the things they should do; as we were doing buildings we thought they should know something about the qualities of bricks and other building materials, and glass, and they should do certain experiments with it. So each class teacher in the year built up a box for a different topic, and then the boxes went round the classrooms, and the children went to the boxes then and they all did something from them; some made up their own experiments having looked at the boxes. One group would be working at the boxes whilst they were doing topic work, some were, perhaps, measuring, others writing up, so they didn't all work on the science at the same time but everyone at some time during the week came round and had a look in the science box in relation to their particular interest in the topic. So although they won't all have done the same thing they will all have done something, say, connected with wood—looked at some of the properties of wood—that sort of thing. There is no set time for it, science can go on at any time, morning or afternoon.

"The group at the box don't require much more attention than other groups, especially now that they've learned to structure their own experiments and think for themselves, and work out exactly what they're trying to find out; then we find that with a little bit of discussion with the teacher they can on the whole walk around the classrooms and find their own equipment and fairly reasonably set out their own experiment and carry on with it.

"We make sure that each one has done some science during the week because they have assignment sheets to show that they've done some science; they have to get a tick on the assignment sheet for it.

"They keep their own records of the work they have done—drawings, diagrams, explanations, write-ups—in a general folder. Someone did a lot of work in cement, and so they've got samples of cement which they put on sellotape and stuck in; so they keep that kind of record in the folder, which we check through every time they've worked in the science field.

"We've tried these two ways because different topics seem to ask different approaches to the science. With the second topic, on the district, we could have got away with doing very little on the science side; a lot of them could have spent much of their time doing maps and things and wouldn't have done much science, so we said in the first place that there were five main things to cover—the ones we catered for in the boxes—and anything else was extra, and fine. But we thought they should do something on these and have knowledge of the five things by the end of the topic, and so it was structured that way. Some children did a lot more of course; some had as their special topic "wood" or "stone" in the cemetery—the children did a lot of work on the marble and other stones—so when they came to do the science work they probably carried on with that as well as doing the other.

"These special topics are their own projects which are brought together to make the big one. For instance I visited the cemetery with my class and each child took whatever aspect of the cemetery was interesting to him, and then we brought all the information together to make the class topic; but they were all working on individual interests. So they might be already doing quite

a lot of science in that. We root round the classes and the school for the materials they need, and if we can't find them sometimes they suggest other things that could be used. We try to find as much of it as possible; we haven't got much standard equipment, it's mostly jam jars and pieces of wood and that sort of thing. We try to make an immediate response to the child's interest, and we often suggest to a child if he can see a way of developing it that he might bring some things from home, and they do bring a lot of things from home, and sometimes do experiments at home as well.

'With the child who would rather go on doing experiments than any other kind of work we find we have to use their particular interests to suggest they communicate their findings in different ways, perhaps with a tape-recorder or in a painting, so then we can pull the strands out and suggest a diary or some write-up.

'Some work individually because that's the way they prefer it, and some in groups. They're shifting groups, though, and they often change group from topic to topic, within friendship groups in the main. They often stimulate each other and get twice as much work done when they're working together; they draw each other out.'

Children's ideas of an 'ideal' teacher

(a) Infants

A head teacher of an infants school reported after a conversation about teachers with several groups of children in the 5 to 7 age range:

'It's extremely interesting how their discussion reflects their concrete level of thinking. They can't really imagine an ideal teacher and they want to relate always to that which they know. Neither can they really explain what they mean by a 'kind' teacher and this word seems to crop up time and time again; they would like a 'kind' teacher. It appeared very strongly from all groups, that first and foremost they want a teacher to be kind. I think I would interpret this as meaning a teacher shows care towards the children. Speaking quietly and calmly and having a sense of fun seems to be quite high on the list.'

Several teachers supplied children's comments on tape which illustrate these points:

'I'd like a teacher wot was nice and ... er ... kind and the class would like her.'

'She wouldn't shout or get angry.'

'I'd like a teacher who would say we could do as we like.'

'My teacher's nice and kind. She helps people.'

'If you've been naughty she'd say "You shouldn't do that" but she wouldn't scold you.'

The subject of punishment featured prominently in what these young children said. They accepted that they should be punished for doing something wrong but disliked the idea of being smacked; interestingly many children feared this even in schools where no physical punishment was ever administered. They felt that the teacher, explaining what they had done wrong, was enough to stop them doing it again.

(b) Juniors 8–10

Again it was more common for children to make comments about what they liked and disliked about the teachers they knew, than to think in terms of a hypothetical 'ideal'.

'She makes me do extra work and I like that. Because when I get some maths done she puts a cross there and I have to do it again to make sure. I like it because it helps me learn.'

'She's nice because she helps me with my work.'

'She's awfully nice about your problems and she's always helping and she talks to you about them.'

'I like to be able to choose when I do things, to do them in my own time. I don't like being bored.'

'If I could have the teacher I'd like it would be a teacher who doesn't lose her temper, someone who's fair, with a sense of humour.'

'I would like her to be nice, kind, but quite strict. Not too strict and not too fussy.'

'It's nice when a teacher says "please" and "thank you".'

'They have their favourites and they judge people by appearances too much, leaping to conclusions. Oh I remember something that P did and she slapped him for it, so it must have been quite naughty, and then it turned out that it wasn't P at all.'

(c) 11–13 year olds at secondary schools

These children had more experience of different subject teachers and it is clear that their reactions to various teachers reflect some of the same preferences of the younger children but there is a greater emphasis upon the teacher's ability to help with understanding of the work.

'I like English best because Miss X is the best teacher.'

'We get very bored in History because the teacher doesn't realize that we don't understand what he's talking about.'

'Don't like Maths, it's horrible. Don't like the teacher. He asks us to put up

our hands if we can't get on and when we do put our hands up he gets cross and says "Put your hands down, how can I see you all at once." He doesn't understand that we're not very clever and have to be told more than once.'

'I like Mr. X, he is strict but he never gets cross and he often makes us laugh.'

'I like Miss X, she is a real friend and will always help us.'

Nevertheless the personal interest and sympathy of a teacher is very much appreciated as this eleven-year-old boy makes clear.

'I like it when teachers are interested in your background, besides in school, and when they take an interest in your subject. I like them to think what it was like when they were being taught and think what they would have liked when they were young. I like them all the time to imagine a child's position in the circumstances and try to realize how difficult it is. When you've done something wrong and they're going to give you punishment, it's best if they get it over with quickly and don't let it drag on, the things they say to you. They should get straight to the point and give you suitable punishment.

'I think teachers, when they're talking to you should not just say what they have to say but ask you if you agree with them and things like that, they don't just tell you what to do but find out how you feel about it. Some teachers when they talk to you, they have some mannerisms which show that they're concentrating and really do care about what you're saying. You can tell if they're not really bothering about what they're saying to you. When you're being punished I think teachers should talk to you about it and say "Why did you do it? What made you do such a bad thing?" And I think they should talk round and sort it out with you. The good thing about that is to try to persuade you not to do it again; otherwise you'll resent your punishment for a long time and it'll make you do more bad things. It doesn't mean to say you shouldn't be punished, but you should have some talk.'

References

This is a selective list of books which are sources of ideas about activities in science and suggestions about organization, equipment and use of the environment. They are all specifically written for teachers and published in the last ten years. The ones included are chosen, from those known to the project team, because they suggest activities of the kind which help children to develop the skills, concepts and attitudes which this project considers important to children's education in science.

Bainbridge, J. W., Stockdale, R. W. and Wastnedge, E. R.

Junior Science Source Book. Collins 1970.

Sixteen chapters full of ideas for activities on diverse topics such as 'Old Recipes', 'The Kitchen Sink' and 'Gardens and Parks'. Some activities are described in detail whilst others are mentioned only as

questions which could be followed up. Teachers without much background knowledge themselves will find the information given about each topic particularly useful. Lists of equipment suppliers, other addresses and references for further background information are included at the end of the book.

Barber, H. M. E. and Hayes, J. Y.

Exploring the Physical World with Children of 5-9. Dent and Son 1973. Consists of three introductory chapters giving general principles, followed by ten chapters on topics such as air, water, time, sound, etc. Each topic is discussed briefly in terms of the kinds of activity suitable for children in the age range considered. There is very limited illustration and detail in the description of activities but a useful discussion of concepts involved. Contains a bibliography of books for teachers and for children.

S. F. King.

Starting Points in Physical Science. Hart-Davis Educational.

A book of practical instructions for making simple apparatus. Not a source of activities, but included here because it provides techniques for using readily available materials which may enable teachers to make use of activities suggested in other books. Contains a large number of illustrations which could be used by children or by teachers.

Nuffield Junior Science Project.

Teachers' Guide 1, Teachers' Guide 2, Animals and Plants, Apparatus. Collins 1967.

These four books plus a booklet *Science and History* were produced by the Nuffield Junior Science Team. *Teachers' Guide 1* expounds the philosophy of child-centred discovery work—and discusses the organization and classroom atmosphere which promote its implementation. *Teachers' Guide 2* contains many case histories, descriptions of work carried out by teachers.

Science 5/13 Project. Published by Macdonald Educational 1972–1974. *With Objectives in Mind*, Introduction to Science 5/13.

Early Experiences

Working with Wood, Stages 1 and 2

Working with Wood, Background Information

Metals, Stages 1 and 2

Metals, Background Information

Time, Stages 1 and 2 and Background Information

Trees, Stages 1 and 2

Structures and Forces, Stages 1 and 2

Structures and Forces, Stage 3

Change, Stages 1 and 2

Change, Stage 3

Science from Toys, Stages 1 and 2

Science, Models and Toys for Stage 3

Holes, Gaps and Cavities, Stages 1 and 2

Minibeasts, Stages 1 and 2

Coloured Things, Stages 1 and 2

Children and Plastics, Stages 1 and 2 and Background Information

Like and Unlike, Stages 1, 2 and 3

Using the Environment: Early Explorations

Investigations Part 1

Investigations Part 2

Tackling Problems Part 1

Tackling Problems Part 2

Ways and Means

Understanding Science 5/13 (in preparation)

This series of Units for teachers provides a storehouse of activities and background information. The 'stages' in the titles refer to stages of development which are described in the introductory book *With Objectives in Mind*. Objectives of the work appropriate at each stage are defined and it is from these that the children's work derives its structure. The Units provide ideas from which teachers can choose and adapt to initiate enquiries or develop those initiated by children. 'Early Experiences' is particularly useful to infants teachers, but has relevance for older children who are beginning this work for the first time. Units for Stages 1 and 2 contain activities suitable for children at Piaget's concrete operational stage and Stage 3 Units provide some extensions for children in transition to formal operational thinking. For two Units there are separate books of background information for teachers, whilst in other cases background is included in the Unit, sometimes in separate chapters, sometimes as notes on the activities. Each Unit lists books for reference and provides useful addresses for obtaining materials which are not locally available.

The Association for Science Education. 'Science and Primary Education' Series. Obtainable from the ASE Headquarters, College Lane, Hatfield, Herts AL10 9AA.

Following the publication of 'Science for the Under Thirteens' a sub-committee of the ASE has been producing documents which discuss particular issues in more detail. These are not sources of activities, but are more concerned with organization for science work in primary and middle schools. Titles of papers so far available are 'The Present Situation: A Review', 'The Role of the Headteacher', 'Use of a Graded Post'.

Check-lists

Introduction

One of the main aims of 'Progress in Learning Science' is to try to help teachers find out about their children's development in abilities, concepts and attitudes which are relevant to learning science so that decisions about the children's experiences can be based on this information. The check-lists, and associated sections of *Raising Questions*, have been produced to help with gathering this kind of information; the project's other book for teachers, *Finding Answers: Guide to Diagnosis and Development*, gives help in making decisions about activities appropriate at different stages of development.

The check-lists have been produced with the help of several working groups of teachers who met to discuss in the first instance what aspects of development and learning in science should be included in the lists. After successive rounds of discussions and redrafting the items in the lists were chosen; but the selection is by no means a 'final' one, for it is quite certain that as the process of trial and refinement continues changes will be seen to be necessary. The items are listed and briefly defined on pages 181 to 186 of *Raising Questions*, but we hope that teachers will modify and supplement these where they are found lacking.

The second step in producing the check-lists was to try to describe how progress in each ability, attitude or concept would show in children's observable behaviour. Working groups have again helped to define statements describing behaviours at progressive levels of development for each item. The lists have gone through three drafts and during the trials and revision of each one decisions have been made about the number of levels, form of statement, etc. It emerged that three levels were the most convenient, and the statements express as far as possible actions or responses which can be directly observed — definite enough to serve as useful criteria but general enough to describe a particular kind of behaviour in a variety of contexts.

Uses of the check-list

The check-lists, one for 'earlier' and one for 'later' development in the age range 5 to 13 years, serve three purposes:

- (i) as a guide to the kinds of actions and responses to look for in order to find out where children are in various aspects of their development

- (ii) as a way of looking at the opportunities provided in the classroom for children to show certain behaviours and to develop certain attributes
- (iii) as a framework for keeping a record of development which reveals where progress is, and is not, being made by individual children.

(i) *As a guide to 'what to look for'*

Children are all the time providing clues to their ideas and attitudes in their responses and actions in everyday situations and activities. In order to pick up the information which is most relevant for providing appropriate opportunities it helps to know what kinds of behaviours are significant. The check-list statements serve this important purpose of focusing observation. At the same time, by being ordered in terms of progressive levels, they provide a framework for interpreting what is observed in terms of development of each ability or attitude.

In day-to-day work the check-lists help in gathering information which is used immediately in making the many decisions which a teacher faces at every point in her work. Making records of all this information would be quite impracticable and not particularly helpful in these circumstances. Thus even though no record is made a check-list has an important part to play in making and using observations.

The information gathered in this way will be more valid and useful if these four things are kept in mind:

—*it is important not to jump to conclusions about a child's development or ideas from insufficient evidence.* To avoid this look for the kinds of behaviours described by the check-list statements, and when an inference is drawn make sure that there is evidence of actions or statements made by the child to support it,

—*evidence of a child's ability of one kind must not be allowed to influence the interpretation of evidence about ability of another kind.* Again this points to asking oneself the question 'what have I really observed which supports this inference?' before accepting it, for it may well be that evidence of well developed ideas of, for instance, 'cause and effect' is influencing the interpretation of evidence of ability in 'problem solving'. The two may be related but are not the same and the evidence about one should be distinguished from that about the other, as suggested in the check-list statements.

—*observations relevant to a particular idea or ability should be made in a variety of situations before inferences are drawn.* One of the advantages of gathering information by observation is that it provides evidence which is not restricted to performance in a particular task, but this advantage will be lost unless a conscious effort is made to gather and bring together a variety of kinds of

evidence when making decisions about a particular aspect of a child's development.

- in any situation a child's behaviour may be influenced by many factors other than his ability.* For instance if he is in a group with others he may respond so as to conform to the pattern of the group behaviour or may not be given the opportunity to show his capability because of the role he is given. It is, therefore, particularly important to observe children in different social settings as well as engaged upon a variety of activities.

(ii) *As a way of looking critically at learning opportunities provided.*

When we look at the actions and responses of pupils what we see depends on the opportunities provided in the classroom as well as on the capabilities of the pupils. The apparent absence of certain behaviours may be an indication of lack of opportunity of a particular kind and not lack of ability. For instance, if we look at the first set of statements in the check-lists, about 'curiosity', we find that the response to new or unusual things is taken as indication of curiosity; but if there are few new or unusual things in the classroom or surroundings it will not be possible for a pupil to show this behaviour, though in other circumstances he may well do so.

It is important, then, to interpret the observations about what a child does in terms of the attributes he shows *within the limitations imposed by the classroom*, not in terms of what he is capable of doing in any situation.

Two things follow from this:

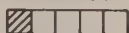
- that the teacher should become aware of any lack in the provision for opportunities to display, and thus to develop certain abilities, concepts and attitudes.
- that the observation made is not a judgement on the pupil; it should not be used to label him. Instead it should be used as information about the opportunities which should be provided to help him.

(iii) *As a framework for keeping records of progress*

In addition to the help the check-list may give in finding out about children without making any record of the information there is value in bringing the information together to make a systematic record at regular, but not frequent, intervals (e.g. two or three times a year). As suggested in *Raising Questions* (page 52) a record in the form of profiles for each child reveals each one's strengths and weaknesses and can be a guide to long-term planning. Cumulative records reveal where

progress is being made by each child and by the class as a whole, and can be a useful basis for a teacher to reflect upon the effect on individuals and the class as a whole of the experiences the teacher has provided.

The advantages and disadvantages of various ways of making a record are discussed on pages 51 to 57 of *Raising Questions*. One way which many teachers have found useful is to make use of the five boxes under each set of statements in the check-list. The idea is that each box represents a point in development, either one indicated by one of the statements or a position in between two statements. Thus if the first statement describes a child's behaviour the record is made like this



If the child seems somewhere between development described by the second and third statements it can be recorded like this



Subsequent records from the same child can be made in the same record sheet by blocking in changes in a different colour, e.g.

First record change at a later time

The following experiences of teachers who have made records using the check-list may be helpful:

- Making a record seems much more like passing a judgement on a child than making an observation which is not given a permanent form. Some teachers felt worried by this, especially with regard to making records about development of attitudes. However this worry can be removed when it is realized that the record is a basis for action, not an assessment of poor achievement. Putting the information on paper is a way of bringing a child's need for help to the conscious level where the teacher can begin to plan worthwhile experiences for him.
- Sometimes there is hesitation about deciding where a child is in a particular aspect and then it is very easy to be influenced by knowledge of the child which may not be relevant. As one teacher, using the first draft, said 'I found at times that I was prejudiced—if I knew that a child was very good and there was some hesitancy I might have marked him up, and on the other hand I might have marked somebody down who I knew was not too bright'. The best safeguard against this is to consciously try to avoid prejudice by keeping closely to the description of behaviour given in the statements and making sure that there really is evidence of that kind of behaviour before the record is made.
- Variations in children's reactions from one situation to another or from one day to another often bring a problem as to whether the general pattern should be recorded or the most advanced kinds of behaviour which have been noticed. When a child operates at a

more advanced level in certain contexts than in others, this is an indication that he is capable of showing this behaviour more often; perhaps he requires more opportunity to extend his thinking or to develop certain attitudes. The progress of the child will thus be helped if the teacher notices the unusual and not only the usual behaviour.

- Children vary in their response to different adults, so two teachers may not agree on a child's record, not because they vary in their interpretation of the same behaviour but because they really observe different behaviour in the same child. Any large variations of this kind are in themselves important information about a child and should not be regarded as error. The possibility of this effect is a reminder that the record is a product of interaction between the teacher and child and should be interpreted in this way by a third person.

At the back of the check-list is an example of a record sheet which many teachers have found useful for keeping records of individual children. This can be detached and photocopied if desired. Records for the whole class can be constructed by bringing individual records together, such as in the way indicated on page 57 of *Raising Questions*.

Finally, please note that there are spaces left at the end of the check-list and record sheet which can be used to add items referring to any abilities, concepts or attitudes which you think should be included.

CURIOSITY

Often seems unaware of new things and shows little sign of interest even when they are pointed out.

Is attracted by new things but looks at them only superficially or for a short time; asks questions mostly about what things are, where they come from rather than about how or why they work or relate to other things.

Shows interest in new or unusual things and notices details. Seeks by questioning or action to find out about and to explain causes and relationships.

ORIGINALITY

Seems to have no ideas of his own; wants to be told what to do and follows directions closely; if not told he imitates what others do.

Extends or adapts ideas which are given to him, but cannot start from his own; rarely initiates activities but makes constructive suggestions once they are started.

From his own thinking produces things or ideas which are novel as far as he is concerned.

WILLINGNESS TO CO-OPERATE

Unwilling to share materials or activities with others unless constantly supervised; seems unaware of others' need and attends only to his own interests.

Works together with others and shares materials because of 'rules' or incentives to do so rather than by mutual agreement. Depends upon external authority to settle differences.

Responds to the needs which others have for help or materials and tries to fit in with others, settling differences without appeal to adult authority.

PERSEVERANCE

Gives up a task at the first sign of difficulty, or if his first attempt does not succeed.

Sticks at a task as long as there is some external incentive in the form of encouragement or ready help. Tries to overcome a problem in the same way even when it is clearly unsuccessful; uses more effort than thought.

Persists despite difficulties or the amount of effort required, as long as there is evident chance of progress towards a goal. Changes his approach if unsuccessful but does not give up.

OPEN-MINDEDNESS

Tends to stick to preconceived ideas ignoring contrary evidence.

Will take notice of some opinions and ideas different from his own but not others, being influenced by the authority behind alternative views rather than the strength of the evidence or argument.

Generally listens to and considers all points of view and relevant evidence; accepts new ideas if the evidence is convincing.

SELF-CRITICISM

Unconcerned about how well he does his work; regards reaching the end product as the aim, apparently unaware that there may be a standard to strive for.

Shows criticism of his own work through comment or action, but does not try to change it or suggest ways in which it could be improved.

Voluntarily attempts to appraise his work or ideas, pointing out satisfactory and unsatisfactory aspects; makes suggestions for improvement and attempts to put them into practice.

RESPONSIBILITY

Seems unaware of what his role should be, or neglects his part, in activities such as routines, clearing up or getting on with work without constant supervision.

Carries out tasks which are expected of him in response to rules or direction but may neglect tasks in the absence of incentives or external constraints.

Fulfills his role in getting on with the work and carrying out tasks expected of him to the best of his ability without constant supervision. Attempts to overcome problems for himself before asking for help.

INDEPENDENCE

Tends to accept anything he is told by others without question. Makes decisions or forms ideas based only on what others do or say.

Very tentative about deciding things for himself in a new situation but more confident in familiar situations; rather more willing to change his ideas than to defend them if others disagree.

Makes up his mind about what to do or think after considering the available evidence or alternatives and is prepared to defend his opinions or ideas and not change them just to be in line with others.

OBSERVING

Rarely gives any indication of noticing new or unusual things unless they are pointed out to him.

Shows that he notices some of the new or unusual aspects but misses details which can be observed, making limited use of his senses.

Uses several senses where appropriate, noticing sequence and a variety of details with reasonable accuracy and objectivity.

PROBLEM SOLVING

Generally unable to approach a problem without help.

Tries one or more ways of tackling a problem without much forethought as to which is likely to be relevant.

Identifies the various steps which have to be taken and tries to work through them systematically.

RAISING QUESTIONS

Tends to accept things without question or asks only superficial questions about what something is called, not about how it works.

Seeks for explanations, by asking or action, but his questions have to be clarified before an answer can be sought or supplied.

Asks questions or poses problems to which an answer can be sought by enquiry and pursues his questioning until he is satisfied or can attempt to find an answer.

EXPLORING

Undertakes little purposeful activity to find things out for himself.

Readily attempts to do things in order to investigate or examine objects or situations but his activity is unsystematic and without apparent plan.

Investigates things in a planned and ordered way, making use of observations as he goes along and extending the activity to other aspects which are revealed.

FINDING PATTERNS IN OBSERVATIONS

Rarely goes beyond a straight report of observations showing little sign of appreciation of any patterns within them which could have been discerned.

Makes rather sweeping statements about his observations, suggesting patterns which are not justified by the evidence.

He puts 'two and two together' and attempts to find patterns in his findings which are justified by what he has observed.

COMMUNICATING NON-VERBALLY

Rarely uses a drawing, model or action effectively to take the place of words.

When his words are inadequate he will attempt to show what he means using non-verbal symbols but does not choose the best form to help others understand him; needs help to grasp information presented in charts, diagrams, etc.

Uses graphs, models, drawing etc... where these make information more understandable to others than words alone. Attempts to make use of information presented in charts, diagrams, etc.

COMMUNICATING VERBALLY

His accounts are somewhat jumbled, he omits important points and assumes others know what he is talking about; he understands others communications through actions (being shown) rather than words.

Puts things reasonably clearly into words but does not distinguish points which are relevant from these irrelevant to what he wants to convey.

Explains things so that the important points can be understood by others with different experience and points of view; makes an effort to understand what others say and to use books for finding information.

APPLYING LEARNING

Rarely makes use of previous learning in a new situation without help or guidance.

Makes an attempt at tackling new problems but may fail through applying skills or knowledge which are not relevant.

Generally uses relevant previous learning to help with new problems.

CAUSE AND EFFECT

Accepts that things happen and mechanical things work without seeking for a cause, or suggests reasons in terms of fantasy or mystery.

Gives explanations in terms of the presence of some component or feature which may play some part in the process but is not itself the cause. Has difficulty predicting what he thinks may happen when certain changes are made.

Seeks to explain physical effect in terms of physical causes even though the correct causal relationship may not be found. Uses the cause-effect relationship observed to suggest what will be the result of certain changes.

CLASSIFICATION

When he groups objects together there is no consistency between the objects in the groups and his declared intentions in grouping.

Can consistently separate things which have a chosen feature from those which do not, but cannot then select a different feature and regroup the objects according to that.

Having sorted objects into groups according to one feature can resort the same things according to a different feature, which he selects himself.

THE CONCEPT OF WEIGHT

Despite evidence to the contrary, judges weight from size and fails to conserve weight when changes make the quantity look different, as when it is divided into pieces, or changed in shape.

Can correctly compare the weights of objects and is not confused by differences in size or other features.

Conserves weight during changes which alter appearances but do not affect the total downward force on the object.

THE CONCEPT OF LENGTH

Despite evidence to the contrary, considers that things can change noticeably in length when moved from one position to another.

Correctly arranges three or more objects in order of length and confirms that changing position makes no observable change in an object's length.

Chooses a suitable arbitrary unit and applies it consistently for comparing and measuring lengths.

THE CONCEPT OF AREA

Claims that the area of a surface is changed noticeably if it is cut up or made to appear different although there is no evidence of change in total area.

Conserves area where the whole is divided into parts or a change makes there appear to be a difference without altering it to any extent that is observable.

Chooses and uses a suitable unit for comparing or measuring both regular and irregular areas.

THE CONCEPT OF VOLUME

Despite contrary evidence he considers that the amount of space taken up by an object or substance can become greater or less if there is change in shape or position which makes it look different.

Appreciates that different shapes can occupy the same amount of space and can compare the capacities of different shaped containers.

Conserves volume in changes or re-arrangements which make the quantity appear very different but do not alter the total volume to any observable extent.

THE CONCEPT OF TIME

Judges the time of day from the events in his daily routine and intervals of time from what happens in them.

Has a good grasp of the sequence of past or planned events within his experience. Unable to compare the time of travel of two objects if their speeds are different.

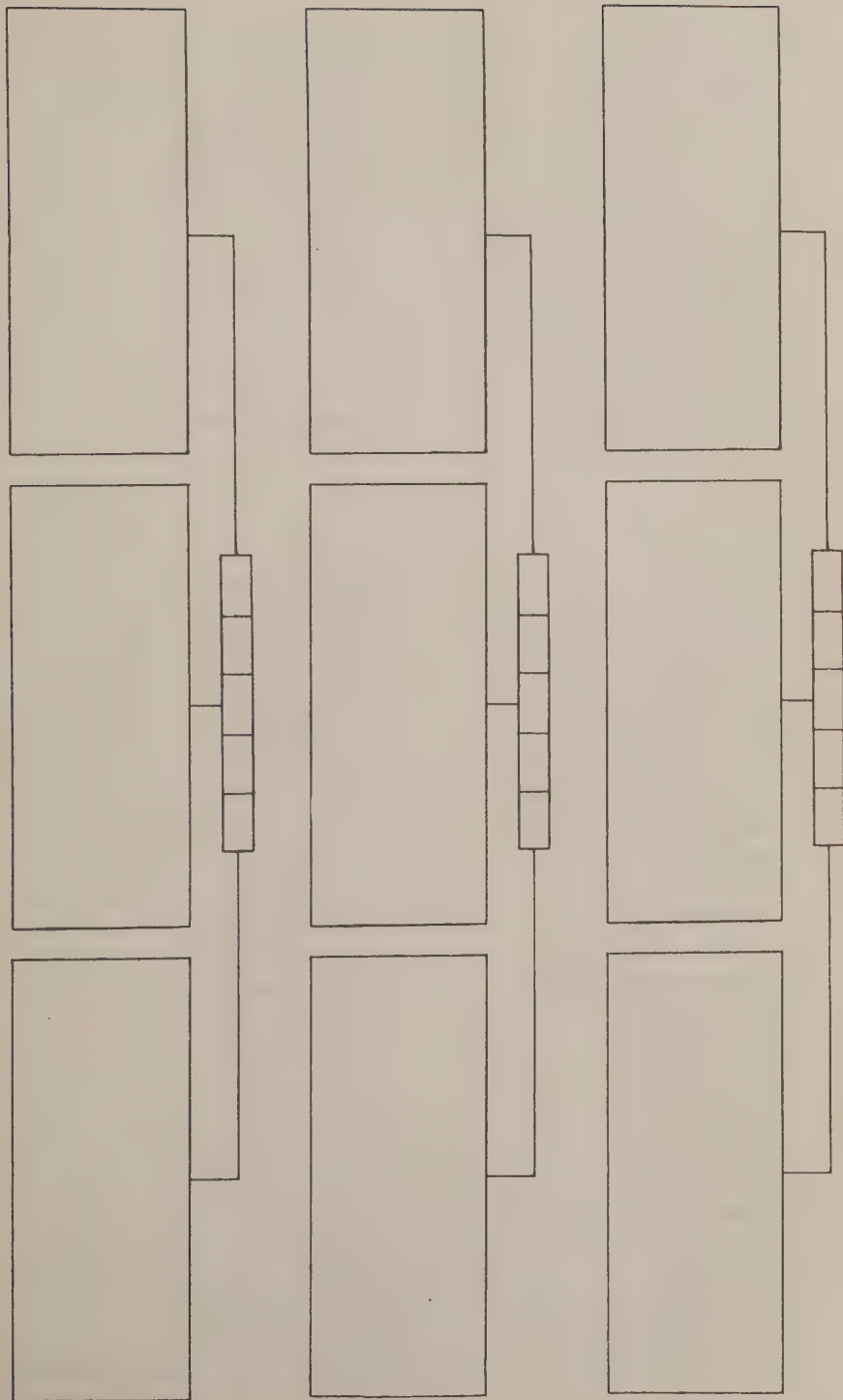
Makes reasonable estimates of the time taken by events within his experience. Takes distance and time into account in judging speed.

THE CONCEPT OF LIFE CYCLE

Makes comments which indicate that he does not consider the possibility of seeds or eggs or other inactive living things as being alive, even though he has seen them change.

Correctly identifies as living the forms of life at various parts of the life cycle of common plants and animals.

Identifies the sequence of development in common living things, beginning at any point in the cycle.



Child's name.....

Second record

Date of birth.....

Filled in by.....

Date of completion.....

Additional comments:

First record

Filled in by.....

Third record

Filled in by.....

Date of completion.....

Date of completion.....

Additional comments:

Additional comments:

Curiosity.....

Originality.....

Willingness to co-operate.....

Perseverance.....

Open-mindedness.....

Self-criticism.....

Responsibility.....

Independence.....

Observing.....

Problem solving.....

Raising questions.....

Exploring.....

Finding patterns in obs.....

Communicating verbally.....

Communicating non-verbally.....

Applying learning.....

Cause and effect.....

Classification.....

Weight.....

Length.....

Area.....

Volume.....

Time.....

Life Cycle.....

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CURIOSITY

Often seems unaware of new things and shows little sign of interest even when they are pointed out.

Is attracted by new things but looks at them only superficially or for a short time; asks questions mostly about what things are, where they come from rather than about how or why they work or relate to other things.

Shows interest in new or unusual things and notices details. Seeks by questioning or action to find out about and to explain causes and relationships.

ORIGINALITY

Seems to have no ideas of his own; wants to be told what to do and follows directions closely; if not told he imitates what others do.

Extends or adapts ideas which are given to him, but cannot start from his own; rarely initiates activities but makes constructive suggestions once they are started.

From his own thinking produces things or ideas which are novel as far as he is concerned.

WILLINGNESS TO CO-OPERATE

Unwilling to share materials or activities with others unless constantly supervised; seems unaware of others' need and attends only to his own interests.

Works together with others and shares materials because of 'rules' or incentives to do so rather than by mutual agreement. Depends upon external authority to settle differences.

Responds to the needs which others have for help or materials and tries to fit in with others, settling differences without appeal to adult authority.

PERSEVERANCE

Gives up a task at the first sign of difficulty or if his first attempt does not succeed.

Sticks at a task as long as there is some external incentive in the form of encouragement or ready help. Tries to overcome a problem in the same way even when it is clearly unsuccessful; uses more effort than thought.

Persists despite difficulties or the amount of effort required, as long as there is evident chance of progress towards a goal. Changes his approach if unsuccessful but does not give up.

OPEN-MINDEDNESS

Tends to stick to preconceived ideas ignoring contrary evidence.

Will take notice of some opinions and ideas different from his own but not others, being influenced by the authority behind alternative views rather than the strength of the evidence or argument.

Generally listens to and considers all points of view and relevant evidence; accepts new ideas if the evidence is convincing.

SELF-CRITICISM

Unconcerned about how well he does his work; regards reaching the end product as the aim, apparently unaware that there may be a standard to strive for.

Shows criticism of his own work through comment or action, but does not try to change it or suggest ways in which it could be improved.

Voluntarily attempts to appraise his work or ideas, pointing out satisfactory and unsatisfactory aspects; makes suggestions for improvement and attempts to put them into practice.

RESPONSIBILITY

Seems unaware of what his role should be, or neglects his part, in activities such as routines, clearing up or getting on with work without constant supervision.

Carries out tasks which are expected of him in response to rules or direction but may neglect tasks in the absence of incentives or external constraints.

Fulfills his role in getting on with the work and carrying out tasks expected of him to the best of his ability without constant supervision. Attempts to overcome problems for himself before asking for help.

INDEPENDENCE

Tends to accept anything he is told by others without question. Makes decisions or forms ideas based only on what others do or say.

Very tentative about deciding things for himself in a new situation but more confident in familiar situations; rather more willing to change his ideas than to defend them if others disagree.

Makes up his mind about what to do or think after considering the available evidence or alternatives and is prepared to defend his opinions or ideas and not change them just to be in line with others.

OBSERVING

Makes limited use of his senses, noticing only some of the things which can be observed in the situation or only those which are pointed out.

Makes all kinds of observations, using several senses, though not able to discriminate the more important from the less important observations for the enquiry in hand.

Makes wide-ranging observations and can select from them the information relevant to a particular problem or enquiry.

PROPOSING ENQUIRIES

Needs help to express a question or problem in a form which is a basis for enquiry; not able to envisage the kind of enquiry needed or what variables to consider

Suggests problems for enquiry but lacks clear ideas about the possible solutions which could be tested or how to control the variables.

Follows up a problem by suggesting possible solutions and ways of testing them which control the variables and enable their separate effects to be investigated.

EXPERIMENTING/INVESTIGATING

Is unable to progress from one point to another in a practical investigation or enquiry without help, failing to grasp the overall plan of the enquiry.

Tries things out somewhat unsystematically unless the various steps in a practical enquiry are planned out for him, in which case he uses materials and collects results satisfactorily.

Has a clear idea of the reason for the various steps in a practical enquiry and can work through them systematically making reasonable decisions with only occasional guidance.

COMMUNICATING VERBALLY

What he writes or says is disorganized and difficult to follow; takes time to understand information in books or verbal directions unless these are accompanied by a demonstration of their meaning.

Seems to have a clear idea himself of what he wants to express but does not always find the words to put it precisely or concisely, prefers to seek information orally than to use books.

Expresses himself clearly, using words appropriately and economically, and at a level which can be understood by whoever receives the message; expands his knowledge through reading.

COMMUNICATING NON-VERBALLY

Relies entirely on words, rarely using a non-verbal form unless told to do so; has difficulty understanding charts, graphs, etc.

Makes use from choice of non-verbal forms of communication but without selecting the best form for a particular purpose; understands diagrams better than mathematical forms of communication.

Selects the kind of graph, chart, table, etc. which communicates a particular kind of information most clearly and can interpret information given in both mathematical and diagrammatic forms.

FINDING PATTERNS IN OBSERVATIONS

Does not relate findings to the purpose of the enquiry or notice any patterns there are to be found without considerable help.

Attempts to look for patterns in findings but rarely suggests possible explanations.

Makes reasonable inferences which fit the evidence and makes some attempt to explain the patterns which he finds in his observations.

CRITICAL REASONING

Tends to make guesses instead of trying to reason something out from the evidence which is available.

Bases his arguments on observations or on his knowledge but fails to take some of the evidence into account when there are several ideas to hold in mind.

Uses observations and relevant knowledge in arguments which are logically consistent.

APPLYING LEARNING

Rarely connects previous learning with new situations in which it could be applied unless told what skill or idea is relevant.

Uses previous experience in new situations once the relationship between the new and previous situation has been pointed out.

Works out what earlier learning could be applied in a new context by using relationships between one situation and another.

CAUSE AND EFFECT

May identify the parts or features which cause something to happen but has little idea of the action of one part on another and cannot predict the effect of changes.

Generally unable to work out the mechanism from his own observations but can follow the reasoning when it is pointed out and use it in predicting the effect of changes.

In situations where it can be observed he identifies the mechanism linking cause and effect and checks his ideas by comparing predictions with further observations.

MEASUREMENT

May or may not use measuring instruments correctly, but is unable to grasp a measurement as a multiple of a chosen unit.

Is able to estimate the measurement of quantities within his experience by judging how many units are likely to be fitted in.

Recognizes that all measurements however careful or fine, are inexact to some degree; has a reasonable idea of the range of error in a particular case.

CONCEPT OF VOLUME

Tends to judge the volume or capacity of an object from one of its dimensions without taking the others into account.

Appreciates the three dimensional quality of volume. Equates the volume of liquid displaced by a submerged object to the space taken up by the object.

Distinguishes clearly between surface area and volume. Appreciates that by changing the shape or dividing up a solid object its surface area can be changed whilst its volume is not noticeably altered.

CONCEPT OF FORCE

Generally tries to explain the movement of an object in terms of its own will or ability to move rather than the action of forces on it.

Explains the movement of an object in terms of one or more forces acting on it, but does not identify forces acting when no movement takes place.

Can identify forces acting on an object whether in motion or remaining still. Appreciates that forces acting are opposing and equal when an object is not moving.

CONCEPT OF ENERGY

Considers energy as if it were a substance which is created and lost somewhat magically, without any continuity between one form and another.

Identifies energy in various forms and recognizes its conversion from one form to another but considers that it can be created at some point in a chain and used up at others.

Describes the changes of form of energy which take place in simple energy chains, recognizing that when it seems to disappear in one form it reappears in some other form.

CONCEPT OF CHANGE

Though he may notice changes which take place in living and non-living material he does not link them with associated circumstances or conditions.

He associates changes with the presence of certain features or conditions. Seems satisfied that the conditions account for the change and does not consider the interactions which take place.

Notices patterns in various kinds of change so that in most cases he distinguishes between broad categories such as growth, development, physical and chemical change.

INTERDEPENDENCE OF LIVING THINGS

Considers that such things as the food and shelter of a living thing exist because the animal exists rather than being dependent upon other living things.

Identifies simple food chains but without appreciating their implications for the animals and plants involved.

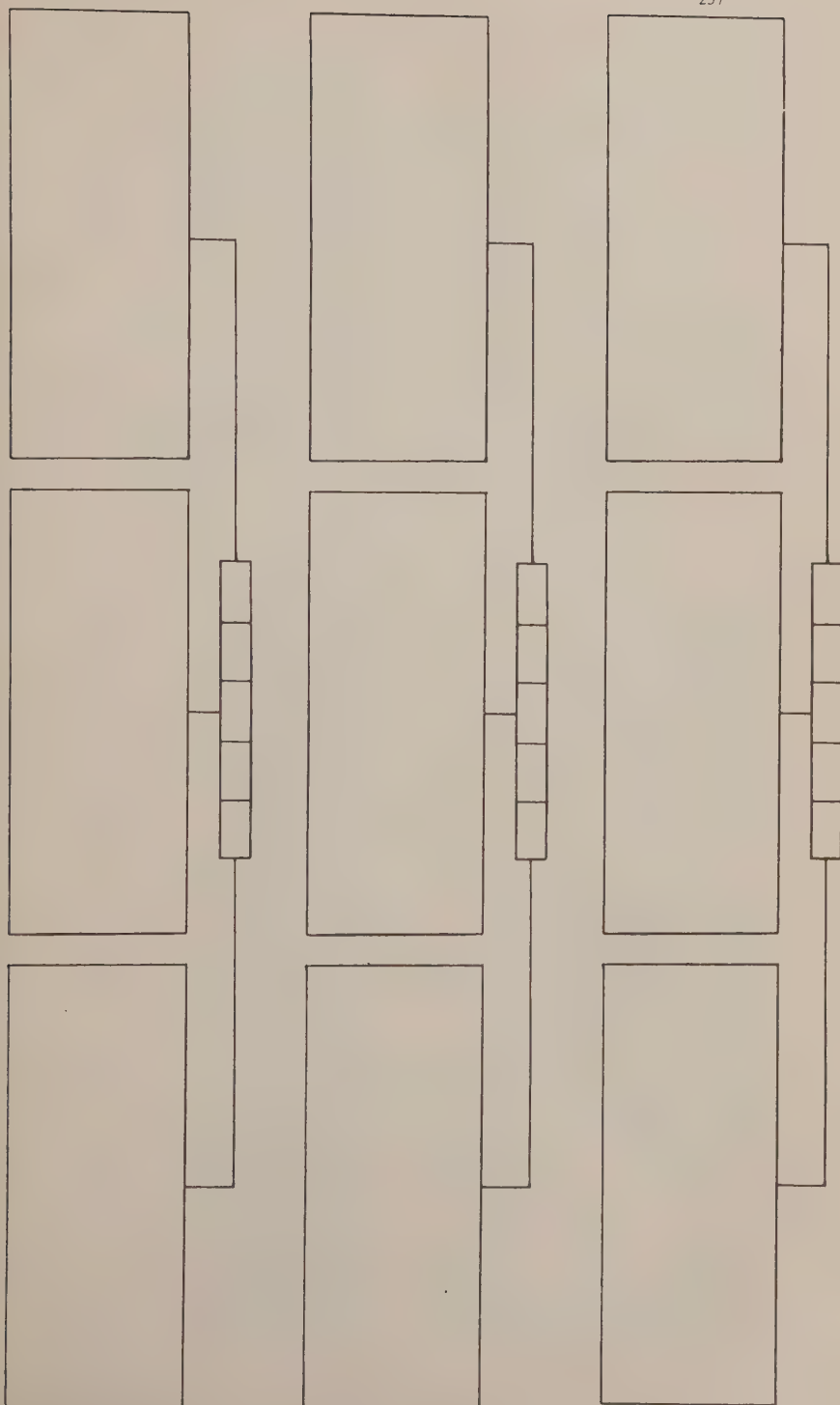
Explains results of changes in animals or in their habitats in terms of the network of interdependence between particular living things.

ADAPTATION OF LIVING THINGS

Considers that the form or structure of the whole or part of a living thing to be a matter of chance or 'just because it is'.

Links the form of parts of living things with their function but with little clear idea of how the relationship might have come about.

Attempts to identify the function of part of a living thing from its form and to suggest influences which could have helped to determine the form.



MATCH & MISMATCH

Developed from the Schools Council Project 'Progress in Teaching Science' *Match and Mismatch* is a course for teachers to provide help in matching activities to the pupils development.

Raising Questions contains 20 topics for study in courses or privately, and two check-lists for assessing attitudes, abilities and concepts relevant to teaching science in the 5-13 age range. Two introductory topics introduce the material. The three themes; Making and Recording Observations about Children; Children's Development and Learning and Making Decisions about the Learning Environment are each covered in 6 topics and can be studied in any order.

Finding Answers offers suggestions relating to decisions about activities and approaches appropriate at various points in development.

The Leaders Guide incorporates *Raising Questions* along with detailed suggestions for each topic and the use of the audio visual materials.

Raising Questions	0 05 003060 4
Raising Questions Leaders Guide	0 05 003062 0
Finding Answers	0 05 003061 2
VCR1 Introduction and Theme A	0 05 003086 8
VCR2 Theme B and Theme C	0 05 003087 6
Audio Visual Pack containing 4 film strips and 2 audio cassettes	0 05 003085 X